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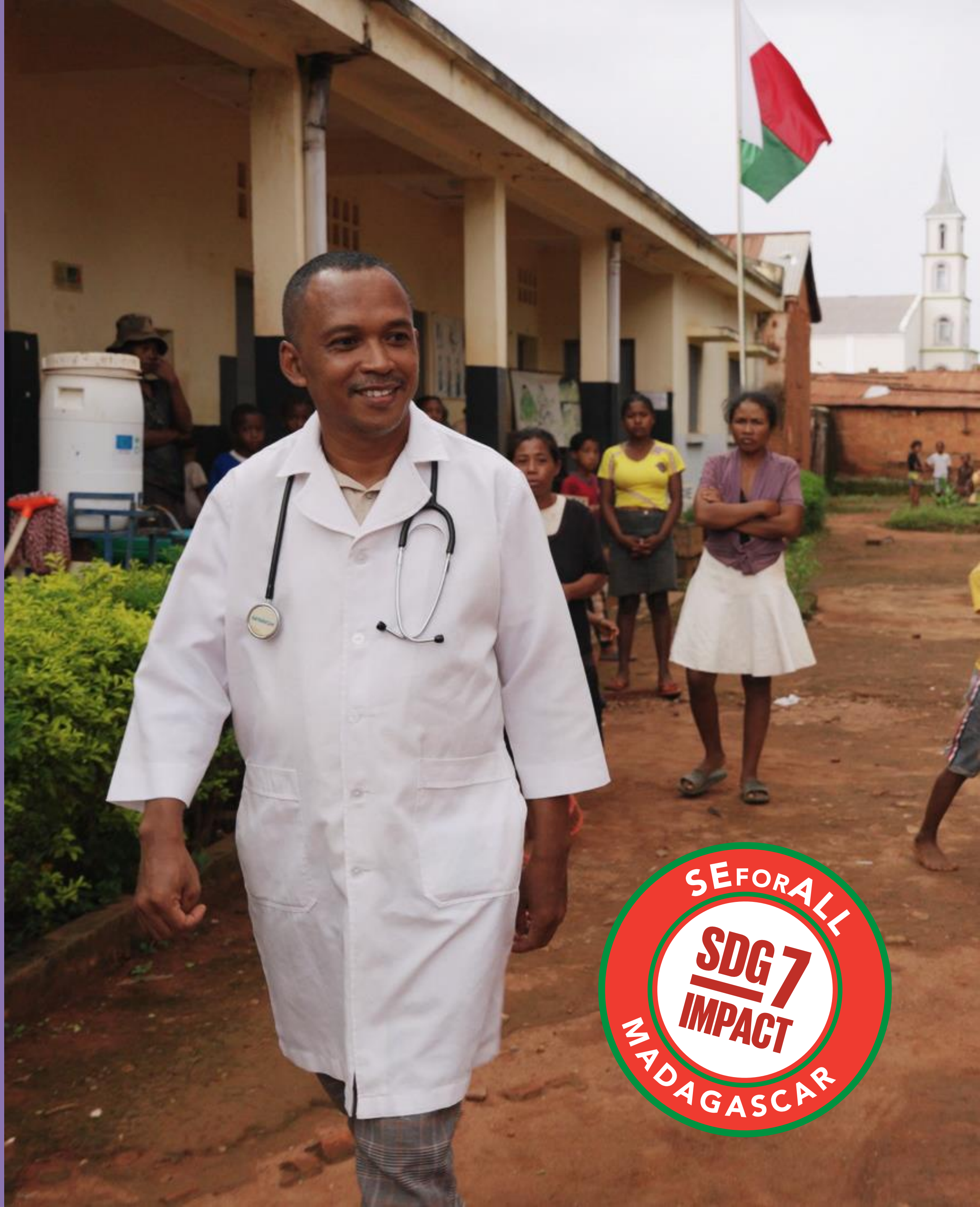
FULL REPORT

Powering Healthcare in Madagascar

Market Assessment and Roadmap for Health Facility Electrification

MARCH 2024



Acknowledgements

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The team and authors are Luc Severi, Marilena Lazopoulou, Louis Tavernier and Charlie Knight (SEforALL); the TTA consultancy team (particularly Xavier Vallvé, Unai Arrieta, Nadia Mrabit, Lauriane Razanajatovo, Lucas Mosca, Isabella González and Rafael Cabanillas); and the AIDES consultancy team (Manitra Rakotoarivelo, Erick Ratsara and Sitraka Rakoto).

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Acronyms

ADER	Rural Electrification Development Agency
AFD	French Development Agency
AP	ADER Call for Proposals in rural electrification
CAPEX	Capital Expenditure
CHRD	District Referral Hospital
CoGes	Management Committee
CSB	Basic Health Centre
DB	Database
DCC	Department of Community Cooperation
DEPSI	Department of Studies and Information System Planning
DER	Department of Energy Emergence
DfM	Doctors for Madagascar
DHRD	Department of District-Level Referral Hospitals
DSSB	Department of Basic Healthcare
EaaS	Energy-as-a-Service
EE	Energy Efficiency
EIB	European Investment Bank
EU	European Union
GHG	Greenhouse Gases
HF	Healthcare Facility
HFE	Healthcare Facility Electrification
IEP	Integrated Energy Planning
MEF	Ministry of Economy and Finance
MEH	Ministry of Energy and Hydrocarbons
MG	Mini-grid
MDTP	Ministry of Decentralization and Territorial Planning
MSanP	Ministry of Public Health
MUSD	Million(s) of US dollars
N.B.	*Nota bene*
O&M	Operation & Maintenance
OPEX	Operational Expenditure
PAYG	Pay-as-you-go
PHC	Powering Healthcare
PV	Photovoltaic
RE	Renewable Energies
SEforALL	Sustainable Energy for All
TFP	Technical and Financial Partners
TTA	Trama TecnoAmbiental
UNDP	United Nations Development Programme
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
USD	US dollars
WB	World Bank
WHO	World Health Organization

Glossary / Key Definitions

GENERAL

Electrification vs. lighting	Electrification refers to the supply and distribution of electricity. It encompasses the installation of infrastructure enabling access to electricity for various uses, such as lighting, but also powering other electrical appliances.
Stand-alone solar plant	Solar power plant designed to operate independently of the main electricity grid.
Back-up solution	Device to ensure continuous availability of electricity even in the event of failure or interruption of the main power supply.
Solar Direct Drive (SDD)	Stand-alone solution comprising a solar module connected directly to a refrigerator. It does not power lighting or other equipment.
Generator	Heat engine coupled to an alternator to generate electricity, providing a portable or back-up power source in situations where grid electricity is not available.
Pay-as-you-go (PAYG)	Business model in which users pay only for the services or products they consume, often through regular instalment payments r ather than up-front fixed fees.

SPECIFIC TO A SOLAR PV PLANT

Photovoltaic module	The smallest complete structure of interconnected cells. Commonly referred to as a "solar module".
Rated capacity at STC	The power delivered at the maximum power point (MPP) under standard test conditions (STC). Usually expressed in Watts peak (Wp).
Charge controller	Electronic component whose function is to regulate the flow ofenergy between the solar panels and the battery.
Inverter	An electronic component that converts direct current (DC) electricity int o alternating current (AC) electricity.
Storage	The accumulation of electricity in a non-electrical form that can be converted back into electricity through the system.
Useful capacity	Refers to the amount of electrical energy that can be efficiently discharged from a battery storage system.

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CHAPTER ONE

Introduction

Objectives, Methodology and Approach

The Roadmap for the Electrification of Healthcare Facilities in Madagascar was developed by SEforALL in close collaboration with the Ministry of Public Health (MSanP) and the Ministry of Energy and Hydocarbons (MEH), and funded by the Global Energy Alliance for People and Planet (GEAPP).

JUSTIFICATION

HEALTHCARE FACILITY DATA

Limited data access and reliability, stored in multiple locations, neither centralized nor easily accessible

COORDINATION BETWEEN PLAYERS

Limited, between energy and health sectors

INVESTMENT NEEDS

Limited knowledge

TECHNICAL SOLUTIONS AND SUSTAINABLE DELIVERY MODELS

Lack of technological options and sustainable financial models adapted to local realities

DUPLICATION BETWEEN MULTIPLE INITIATIVES

E.g. needs assessment tools, electricity delivery model pilots, etc.

OBJECTIVES OF THE ROADMAP

01

To provide the government and its TFPs with data on the extent of the energy deficit that persists in the healthcare sector, including non-electrified and semi-electrified facilities.

02

To provide the strategic information and implementation guidelines that the government and its partners need to allocate the investments required to implement sustainable electrification of healthcare facilities (HFs).

03

To propose long-term sustainable model options, including innovative approaches for the provision of continuous and reliable electricity services. This does not involve formulating a tailored solution for each HF.

METHODOLOGY

Data were collected using both quantitative and qualitative methods, and from a variety of sources:

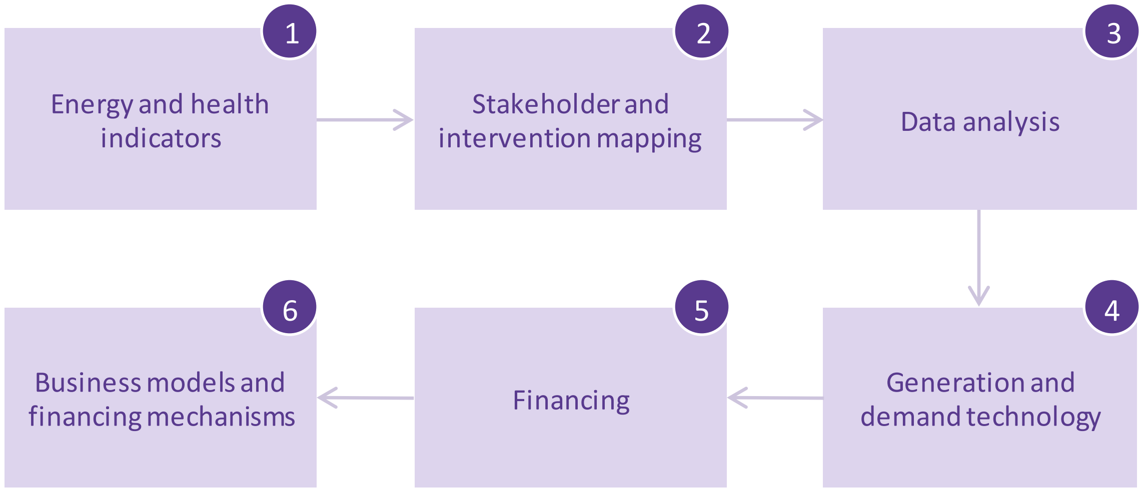
- Stakeholder consultation
- Working group
- Visits to 15 healthcare facilities
- Expert interviews
- Best practices / Benchmarks
- Databases
- GIS mapping
- Documents/information

The Market Assessment and Roadmap for the Electrification of Healthcare Facilities was developed in close collaboration with key stakeholders in the sector: the government, TFPs, NGOs and the private sector.

APPROACH

The market assessment and roadmap consists of several elements, including stakeholder and intervention mapping, data analysis, technology assessment, financing mechanisms, business models and a roadmap for the electrification of HFs in Madagascar. The market assessment and roadmap for the two types of HFs - CSBs and CHRDs - are presented in the following chapters.

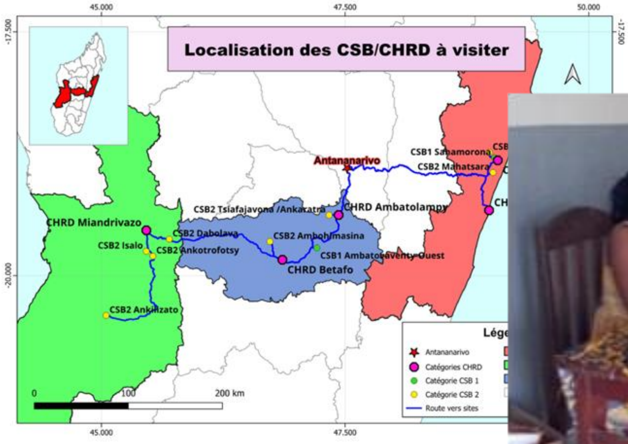
MARKET ASSESSMENT AND ROADMAP OVERVIEW



Field visits conducted and feedback gathered from various stakeholders for better understanding of the realities

FIELD VISITS

- A **sample of 10 CSBs and 5 CHRDs to be visited** was determined according to criteria and sites validated by the MSanP, allowing a broad representation while respecting the time and budget factors imposed by SEforALL.
- Each visit included **interviews** with HF human resources, completion of a **detailed**[1] multi-dimensional **questionnaire** (including medical aspects, electrical systems, human resources, financing, etc.) and **observations**.
- **Three additional preliminary visits** to CHRDs and CSBs were carried out to test the questionnaire as thoroughly as possible.



HEALTH-ENERGY WORKING GROUP

- A working group **made up of representatives of the Malagasy government and TFPs working in the health and/or energy sectors** was set up, with fortnightly online meetings (3 held). These meetings provided an opportunity to present and discuss the project's conclusions, and to share feedback on each other's experiences.

OTHER TYPES OF STAKEHOLDER CONSULTATION

- 30+ **bilateral interviews** (online and face-to-face) with representatives of the Malagasy government, TFPs, NGOs and private-sector companies.
- **Two multi-stakeholder workshops** were organized in August 2023 and October 2023 to inform, exchange and supplement the information for the market assessment and roadmap.

(1) See Appendix for detailed questionnaire.

CHAPTER TWO

Market Assessment

CHAPTER 2.1

Madagascar's Healthcare System

Source: WHO, World Bank - 2020 and 2021, bilateral interviews

HEALTH SITUATION - KEY FIGURES

392/100,000

Maternal mortality rate (2020)

World average: 157

Sub-Saharan Africa average: 545

0.25/1,000

Number of qualified health professionals (doctors, nurses and midwives) per 1,000 people.

WHO recommends 4.45/1,000

45,3/1,000

Infant mortality rate (2021)

World average: 28.4

Sub-Saharan Africa average: 49.9

64.5 years

Life expectancy: (2021)

World average: 71.3

Sub-Saharan Africa average: 60.2

NON-MEDICAL FACTORS INFLUENCING THE HEALTH SITUATION:

Social

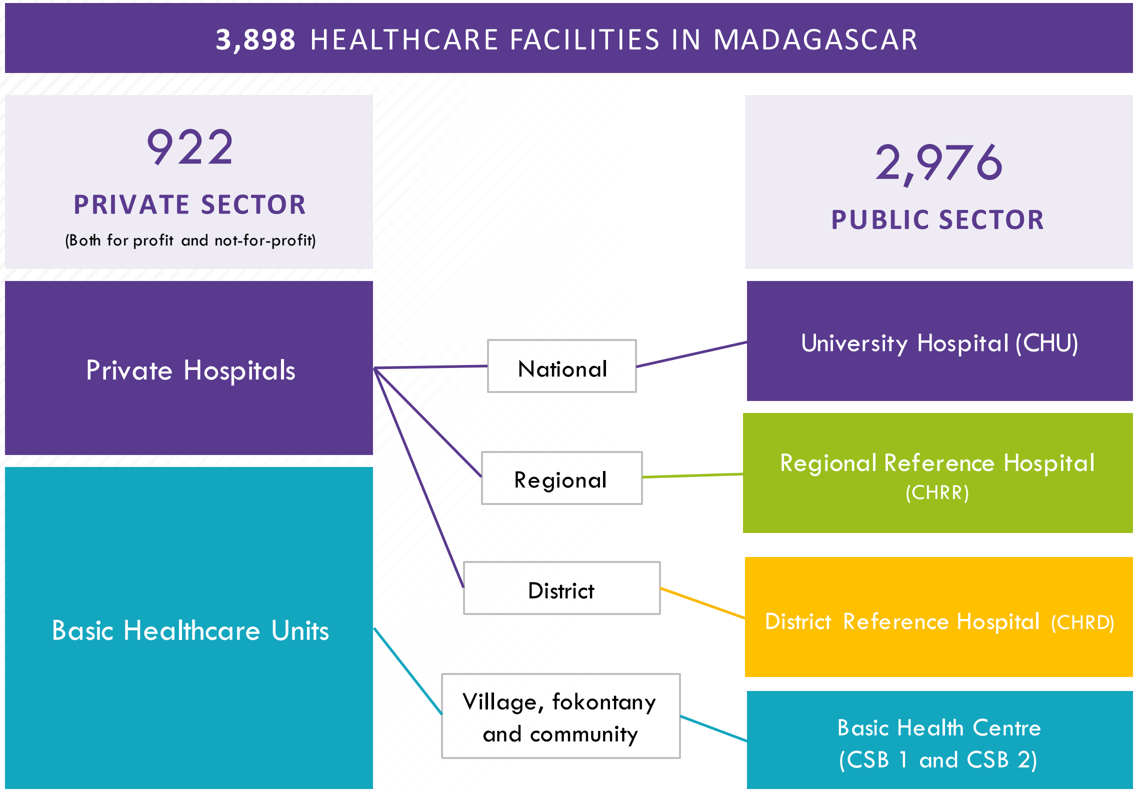
- Income level
- Access to social protection
- Education level
- Job type

Climate change and crises

- Causing malnutrition or food crisis, decline in living standards and economic activity, disease, destruction of HF

Madagascar's healthcare delivery system – public facilities vs private sector

THE SYSTEM IS LARGELY MADE UP OF PUBLIC FACILITIES, ALONG WITH PRIVATE FOR-PROFIT ESTABLISHMENTS AND NGOs



PUBLIC SECTOR

- The public sector accounts for the majority of HFs; as of 2023 76% of HFs were in the public sector.
- The public sector is present throughout the country, with healthcare structures at all administrative levels.

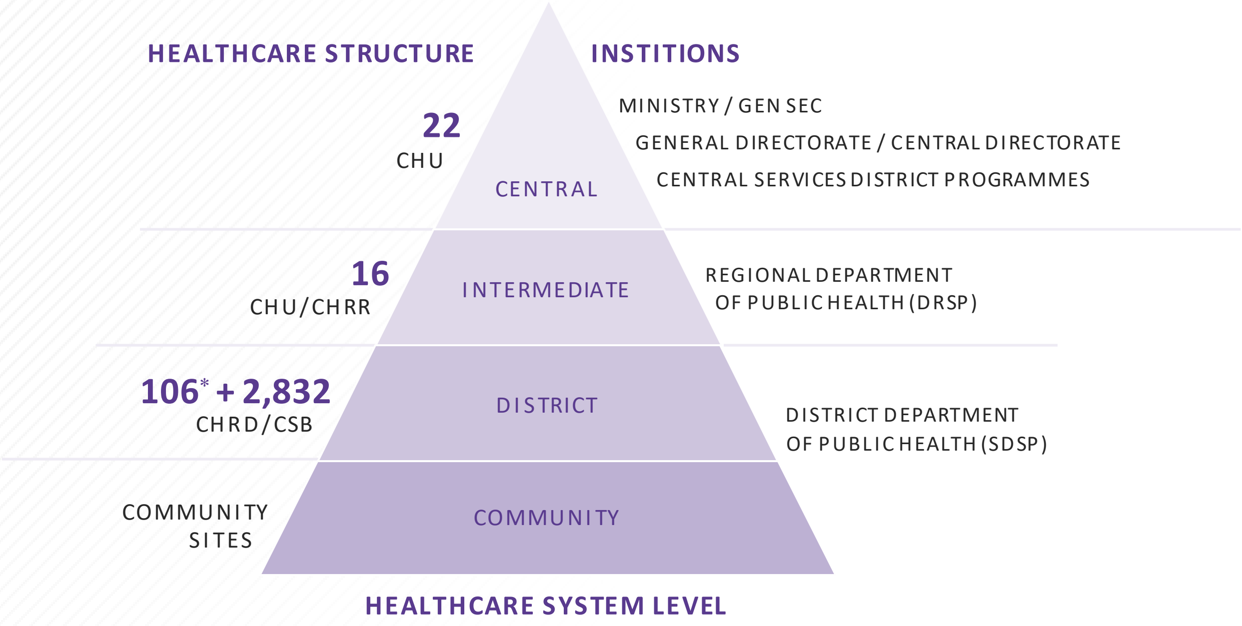
PRIVATE SECTOR

- The private healthcare sector is made up of a number of players:
  - For-profit: Private companies
  - Not-for-profit
    - Faith-based organizations
    - NGOs
    - Other
- Most of the private sector is located in urban areas, and coverage is growing.
- As of 2023, 24% of HFs were in the private sector.

Source: Modified by TTA, based on USAID/Projet ShopsPlus - Evaluation of the private health sector in Madagascar (2017); MSanP/DEPSI

Madagascar's healthcare delivery system – 4 structures

PUBLIC HEALTH SYSTEM



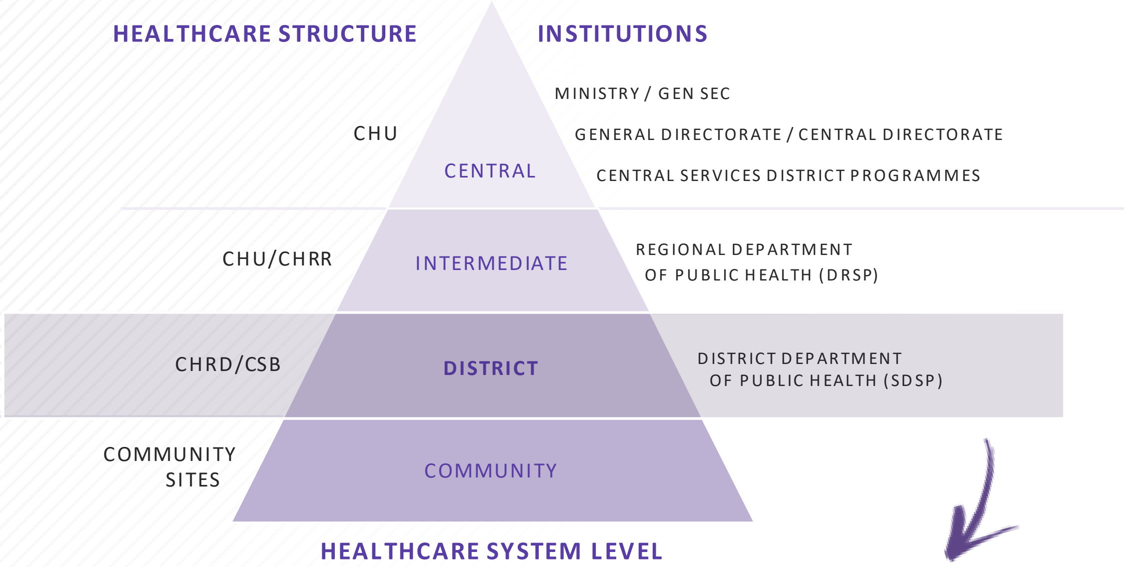
XX No. of healthcare facilities

STRUCTURE	BRIEF DESCRIPTION
CHU: *(Centre Hospitalier Universitaire)* University Hospital	• Top of the pyramid and last resort • Highly specialized technical platform and with a wide range of services • Population served >150,000
CHRR: *(Centre Hospitalier de Référence Régionale)* Regional Refer Hospital	• Located in regional capitals
CHRD: *(Centre Hospitalier de Référence de District)* District Reference Hospital	• CHRD1: Provides services for referrals from CSBs • CHRD2: CHRD 1 + takes on surgical referrals
CSB: *(Centre de Santé de Base)* Basic Health Centre	• 1st level of contact with a public health structure • Basic healthcare • CSB1: Care provided by paramedics • CSB2: Care provided by one or more doctors and paramedics; additional services

Source: Modified by TTA, based on Health Sector Development Plan 2020-2024, number of CHRD and CSB in October 2023 provided by MSanP DSSB and DHRD; (*) 13 new CHRD2 are under construction/inauguration.

Focus on CSBs and CHRDs

CSBs and CHRDs offer health services to a large proportion of the population and electrifying them can have a real impact



- **Largest number** (2,976) of HFs in the country, representing 75% of HF (public and private)
- HFs with **the lowest access to electricity**
  - if access to electricity is available, it is often inadequate to meet needs
- HFs often **in rural or isolated areas**

Distinction between CSBs and CHRDs made by the Ministry of Public Health (MSanP)

- MSanP developed standards for CSBs and CHRDs in 2017, with WHO support
- These standards were challenged by feedback from stakeholders consulted, and field visits

	CSB1	CSB2	CHRD1	CHRD2
POPULATION SERVED	≥ 4 000	≥ 8 000	≥ 20 000	
LEVEL	Municipality		Town	
EXISTING SERVICES	• Prenatal consultation • Pharmacy • Family planning • Delivery (if resp. is a midwife)	• Maternity ward • Medicine • Pharmacy • Family Planning • Prenatal consultation • Vaccination	• Maternity ward • Paediatrics • Medicine • Pharmacy • Family Planning • Prenatal consultation • Vaccination • Minor surgery • Dentistry • Ambulance • Emergency care	• CHRD 1 + operating theatre → Distinction between CHRD1 and CHRD2 is recent
	A CSB provides a "Minimum Activity Package"			A CHRD provides an "Additional Activity Package" to complement the CSB
NUMBER OF ROOMS	2 to 5	2 to 10 (standard: 7, or 9 for rural CSB2s)	More than 10	
SUPERVISOR	Registered nurse (often a midwife)	Doctor	Chief Medical Officer	Medical Inspector

Source: Norms and Standards CSB 2017 /DSSB/MSanP, Norms and Standards CHRD 2017 /DHRD/MSanP, field visits SEforALL/PHC

Medical services mainly free or offered at a reduced price - a minimal potential source of funding for HFs

MEDICAL SERVICES	DEPRIVED/ INDIGENT	PUBLIC	SUPPORT	FOREIGNERS	OTHER
Outpatient consultations: general practitioner, consultant, professor	Free	Free	Paying	Paying	Free if referred from another HF
Accommodation (according to category)	Symbolic fee	Same rates between MGA 500-40,000/night (USD 0.1-9)[1]			Free for healthcare personnel and their families
Forensic services	Fixed prices for all between MGA 5000-50,000 (USD 1-11)[1]				
Procedures: medical and surgical, routine care, dentistry, functional rehabilitation	Each service corresponds to a number of K. Depending on the patient category, the price is multiplied by its coefficient:				
Paraclinical examinations	Coefficient: 350K	Coefficient: 525K	Coefficient: 1,050K	Coefficient: 2,100K	
Pharmacy	Drug price multiplied by 1.35, the supplement of which is used as a contribution towards the dispensing agent's salary				

- The highest rates (for specific surgical procedures) range from USD 23 for deprived individuals to USD 140 for foreigners, and are therefore **much lower than their costs.**
- Also, it seems **difficult to allocate certain revenues to other purposes, e.g. access to electricity for HFs.**

Source: 2017 hospital tariffs/DHRD/MSanP, SEforALL/PHC field visits; (1) Course on xe.com from 2/11/2023; Definition of Deprived: individuals identified and counted as such by the municipality. Care: individuals benefitting from health insurance/mutual insurance through their employer (public and private sectors).

CSBs and CHRDs also often underequipped and somewhat basic compared to standards 1 2

CSB STANDARDS AND REALITIES

EQUIPMENT

ELECTRICAL EQUIPMENT	CSB2	CSB1	REALITY (SEforALL VISITS)
Steam sterilizer + spare part	1	1	Often no sterilizer at all, or even gas or coal sterilizers
Electric/Solar refrigerator	1	1	Present and functional in 50% of cases
Tablet / Laptop	1	1	1 computer at 1/10 sites
Microscope	1	0	Not present
Mucus extractor	1	1	Not present

- Reality shows that **equipment standards are not always met**, not least because of a lack of funding.
- However, the presence and proper functioning of medical and non-medical equipment is the **basis for defining the electricity needs of CSBs.**

LIGHTING

LIGHTING REQUIRED	5 ROOMS	7 ROOMS	REALITY (SEforALL VISITS)
1 single-ignition light point	5	7	• Almost all CSBs have access to lighting • However, this corresponds to only 1/3 of the normative requirements in terms of number of bulbs
2 single-ignition light points	3	3	
6A/10A socket	10	10	
1.2m neon light	7	8	
Window	4	5	

- There are no **standards for electricity, only for lighting.**
- For half of the sites visited, **electrical standards* are not respected** in terms of wiring and personal protection.

Source: Normes et Standards CSB 2017 /MSanP, field visits SEforALL/PHC (10 CSB), project working group; *French Standard C 15-100, applicable in Madagascar.

CSBs and CHRDs also often underequipped and somewhat basic compared to standards

1 2

CHRD STANDARDS AND REALITIES

Equipment

Ministry of Public Health standards define requirements for the following services:

- Admission-Triage-Emergency and Transfer
- Obstetrics and gynaecology
- Medicine
- Surgery
- Dentistry
- Functional rehabilitation
- Laboratory
- Blood transfusion station
- Radiology
- Ultrasound

SURGERY	NUMBER
Anaesthesia equipment	2
Electric surgical aspirator	2
Electric mucus aspirator	2
Electric scalpel	2
Air conditioner	2
Examination lamp	2

According to what was observed during the field visits, there is a notable difference between:

1. Standards and equipment actually on site
2. The level of equipment between CHRDs

Having more equipment than CSBs, CHRDs have higher energy requirements.

Electricity

- No standards for electricity (or lighting, unlike CSBs).
- There is often already access to an energy source, but there is a real need for back-up or complementary solutions to cover particular needs (insufficient capacity, power cuts, electricity use quotas defined by the local council).
- There are significant differences in the level of electricity available between CHRDs. In addition, electricity requirements vary significantly depending on the medical and non-medical equipment operating on site.

Source: CSB Normes et Standards 2017 /MSanP, SEforALL/PHC field visits (5 CHRD)

Construction standards established in addition to equipment standards, but reality does not measure up

CSB STANDARDS AND REALITIES

CSB1 with 5 rooms :

N° of Room	Room use
1	Health consultation room
2	Midwife office room
3	Birth room
4	New born room
5	Pharmacy

- The **CSB** infrastructure **standards** specify the number of rooms and their allocation for the main building and annex buildings. **The surface area, type of flooring, ceiling and wall cladding are not mentioned.**
- Major **refurbishments** should be handled by the MSanP (at central, regional or district level) and minor refurbishment by the municipality.
- Visits and feedback from certain stakeholders indicate that rural CSBs in particular **often have dilapidated** infrastructures.

CHRD STANDARDS AND REALITIES

Room / purpose	Room Space	Ground	Roof	Wall
Hospitalization / Medical service for men	60 m^2 (6 beds) – 3m high minimum	Floor tiles	Plasterboard	Plaster + tiles 1.50 meter high minimum
Hospitalization / Medical service for women	60 m^2 (6 beds) – 3m high minimum	Floor tiles	Plasterboard	Plaster + tiles 1.50 meter high minimum
Hospitalization / Medical service for pediatry	60 m^2 (6 beds) – 3m high minimum	Floor tiles	Plasterboard	Plaster + tiles 1.50 meter high minimum

- The **standards are defined by the type of department** (technical, administrative blocks, annex buildings, etc.) and specify the surface, type of flooring, ceiling and wall cladding to be used.
- Infrastructure maintenance is carried out by the logistics support service. Financing and major repairs are not specified.
- Visits and feedback from certain stakeholders indicate that **standards are not always respected and building maintenance is not always carried out properly.**

Source: CSB Normes et Standards 2017 - DSSB/MSanP, CHRD Normes et Standards 2017 - DHRD/MSanP, SEforALL/PHC field visits, project working group

Different sources of financing for HFs to cover their investment and operating costs *a priori*

✔ Existing ✘ None

IDENTIFIED FINANCING	FUNDER	CAPEX THAT CAN BE COVERED	OPEX THAT CAN BE COVERED
Budget line in Finance Act for MSanP and HFs (credit allocations)	MEF	✔ Equipment	✔ Salaries of public-sector medical staff
Operating subsidies from municipalities including HFs • The HF provides an annual work plan (AWP) with budget • A management committee (CoGES) allocates funds on the basis of the AWP	MID/ Municipality	✔ Minor maintenance, cleaning, repairs	✔ Electricity and water quotas included per HF
Subsidy for security guard and dispensing agent compensation • Contribution to security guard and dispensing agent salaries	MID/ Municipality	✘	✔
Municipality's own resources allocated via the CoGES • Covers the remainder of the security guard's salary, and that of the dispensing agent • To be defined on a case-by-case basis	Municipality	✘	✔
CSB allocation (Decree no. 2019-2117) • As part of the Madagascar Emergence Initiative • Plenty of discussion, including about electricity and water	MSanP via MEH	✔ Purchase of minor equipment	✔ Minor maintenance, cleaning, repairs
Local Development Fund (FDL) • To support local investments according to particular criteria	MID	✔ Part of the CAPEX for electrification could be covered	✘
NGO donations	NGO	✔ Medical and non-medical equipment	✔ Technical assistance including capacity-building
TFP projects and programmes • Electrification, refurbishment/construction, medical and non-medical equipment, digitalization	PTF	✔ Investments	✔ Technical assistance including O&M, capacity-building

Source: Direction de la Coopération des Collectivités (DCC)/MID, SEforALL/PHC field visits, project working group

CHAPTER 2.2

HF Electrification: CSB & CHRD

Source: Databases of various actors including World Bank/LEAD, MSAnP/DEPSI/DHRD/DSSB

KEY FIGURES

2,976 / ~ 2,850

Total number of CSBs + CHRDs/ Number without reliable access to electricity

10% / 25%

Percentage of CSBs/ CHRDs respectively connected to JIRAMA national grid

30%

Percentage of CSBs with access to basic lighting

24%

Percentage of CSBs without access to electricity for cold chain

0h-24h

Wide variation in electricity availability and numerous power cuts

Access to reliable, up-to-date data on CSBs and CHRDs a real challenge, given multitude of existing databases

DATA SOURCE

Data on health centres can be obtained from several sources. Database quality varies between sources.

DATABASE (DB)

There is no common reference for all databases permitting information to be merged for each HF. Databases are sometimes modified by different stakeholders, and data quality is lost (e.g. geographical coordinates found in different formats, with errors).

HF TYPE

The type of health centre is always indicated in the databases. New definition of CHRD1 and 2 to be included in the future.

APPLICATION

The databases are each used for different purposes. It is important to be able to summarize applicable categories (electrification status, cold chain, building structure status, etc.).

UPDATING DATABASES

It is often impossible to track changes made to databases and database reference dates.

ELECTRIFICATION STATUS

The definition of electrification status is not standardized across the country, and details of energy service are often difficult to obtain. A binary "yes/no" indication for access to electricity is not sufficient.

DATA GATHERING

Several databases collected from various stakeholders for this study:

I.E, THE MALAGASY GOVERNMENT, TFPs AND THE PRIVATE SECTOR

✔ Existing ! Partial ✘ None

STAKEHOLDER	BRIEF DESCRIPTION OF DB	DATA AVAILABLE IN THE DB			
		HF TYPE	GEOLOCATION	VISITOR NUMBERS	ELECTRIFICATION STATUS
World Bank	Field surveys of 1,189 CSBs during the LEAD project (2022) and list of 47 electrified CSBs	✔	✔	✔	✔
SEforALL – IEP	Compilation of databases carried out as part of the *Integrated Energy Planning* project (2023)	✔	✔	!	✔
SEforALL – PHC	Field visits to 10 CSBs and 5 CHRDs (2023)	✔	✔	✘	✔
WeLight	List of 171 villages (53 already electrified) to be electrified by mini-grids	✔	✔	✘	✘
MSanP CHRD	List of 23 CHRD1s and 75 CHRD2s provided by MSanP/DHRD	✔	!	✘	✘
Africa Greentec	List of 7 villages to be electrified by mini-grids	✔	✔	✘	✘
UNICEF	List of 7 CHRDs and 61 CSBs refurbished (upgrade of buildings and electrification)	✔	!	✘	✘
GIZ (BMZ fund)	List of 3 CHRDs and 3 CSBs electrified	✔	✔	✘	✔
ANKA (including DfM)	List of 24 CSBs electrified via mini-grids or stand-alone solar plants, and 138 pending electrification	✔	✔	✘	✘

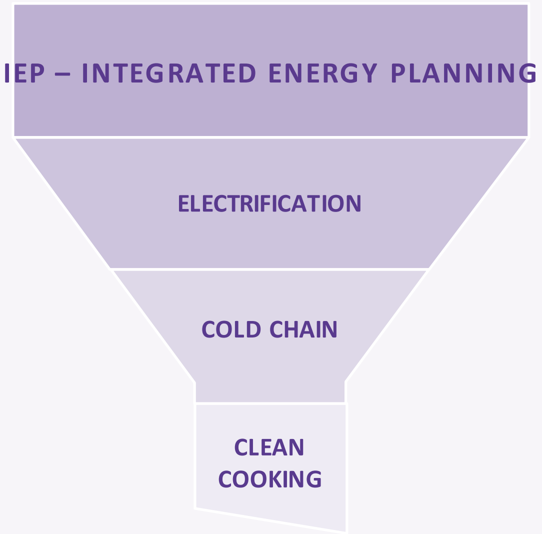
Source: stated above

Steps taken to produce consolidated and updated database, and map of HFs

1. COLLECTING DIFFERENT DATABASES
2. CONSOLIDATING & CLEANING UP DATABASES
3. HARMONIZING WITH & COMPLETING THE IEP MASTERLIST - MEDICAL COLD CHAIN
4. UPDATING THE IEP MASTERLIST - MEDICAL COLD CHAIN
5. INTEGRATING THIS MASTERLIST INTO THE GLOBAL IEP DATABASE

EXPLANATION

- Steps 2 and 3 are laborious due to the different spellings of the names of fokontany (villages/groups of villages), lack of geolocation, data updated to a greater or lesser extent, etc.
- SEforALL is setting up another project in Madagascar called Integrated Energy Planning (IEP), covering electrification, cold chain (including medical) and clean cooking throughout the country.
- The HF mapping exercise done as part of the PHC project (CSB and CHRD) feeds into and forms an integral part of the overall energy mapping of the IEP.
- This will make it possible not only to centralize data (currently disparate), but also to ensure that it is regularly updated in the interests of all stakeholders (government, TFPs, NGOs, private sector, research, etc.).
- ***Result:*** *IEP DB includes updated and consolidated information from different sources on CSBs and CHRDs, as the sole reference in the future, including the location of HFs for their cartographic representation.*

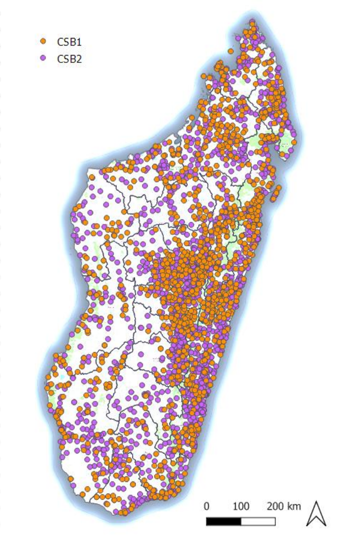


DATA GATHERING

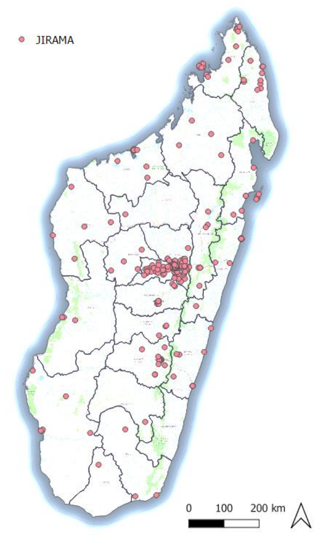
Harmonized, high-quality database to optimize the efficiency of electrification projects

EXAMPLES OF FILTERS: HF CATEGORIES, PROJECTS

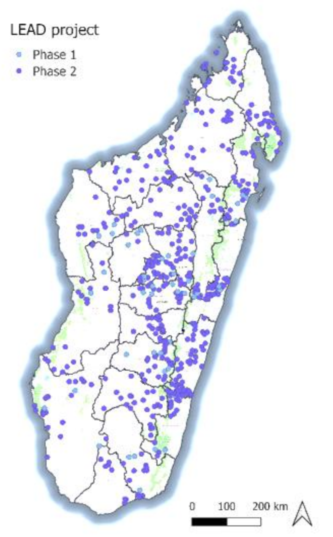
LOCATION OF CSB1 AND CSB2



LOCATION OF JIRAMA CONNECTION



LEAD PROJECT LOCATION



WELIGHT MG LOCATION

Other maps will be available at a later date via IEP
(some preliminary maps are available in the appendix)

FEEDBACK FROM GIS ANALYSES

- **Geographical distribution** is available on a national scale. A more in-depth approach, taking population density into account, could identify areas where access to health centres is more complicated.
- The HFs connected to JIRAMA are mainly located around the capital and the regional capitals.
- The **LEAD** project **has sought to electrify HFs across the country relatively uniformly**, although the south-west seems to be slightly less covered.
- **WeLight MG** projects **are mainly concentrated in the north and east of the country.**
- **A more detailed analysis of site accessibility** could also be carried out by assessing distances from main roads.

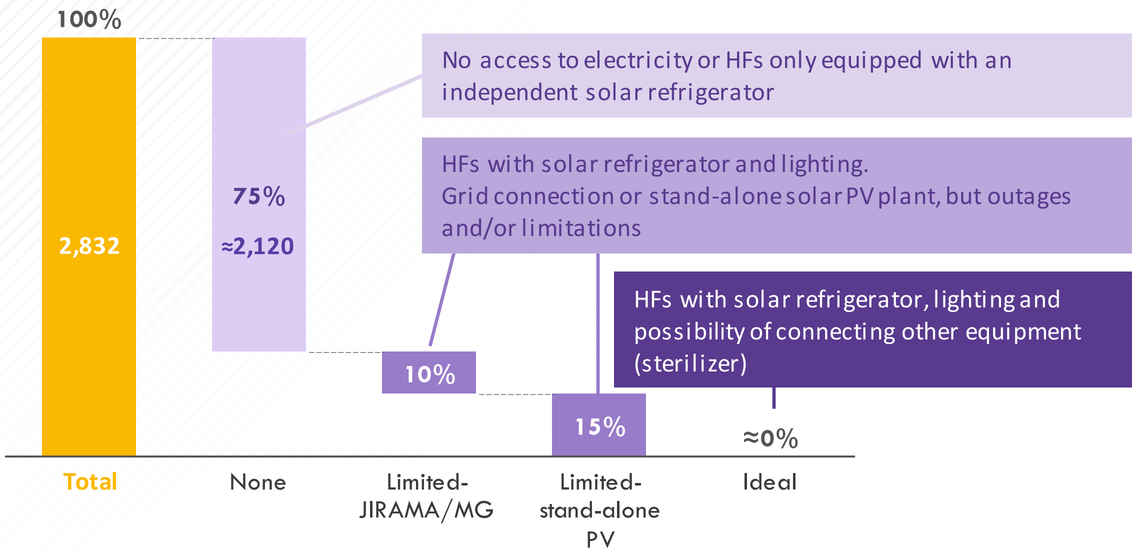
Source: IEP database

Sizing the energy access gap in CSBs

MOST CSBs ARE NOT ELECTRIFIED; THOSE THAT ARE, ARE OFF-GRID AND DO NOT MEET THE REQUIRED STANDARDS

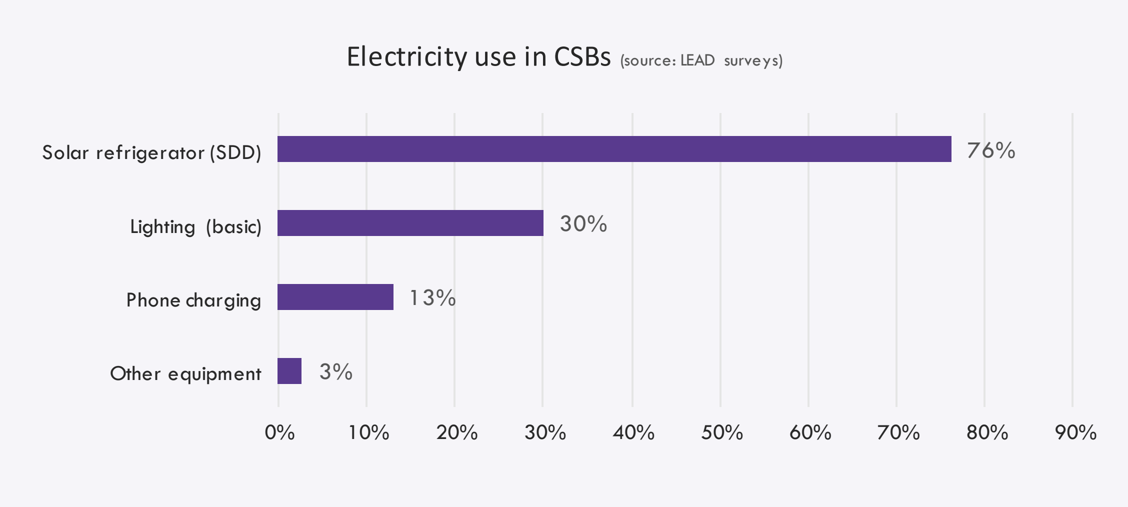
At present, access to electricity in the CSBs is **rudimentary and limited mainly to basic lighting provided by small solar panels installed on roofs**. Although there is electricity, it does not allow for satisfactory improvement of the CSBs. The **breakdown of access to electricity in this context** is shown below:

ACCESS TO ELECTRICITY



THE LEAD ENERGY AUDIT IN 2022 INCLUDED 1,189 CSBs

- Although not enabling the health centre to be supplied with electricity, it was found that **76% of the sites visited had a functioning solar refrigerator.**
- Around **30% of sites had access to lighting,** but sometimes only to a very limited extent.
- **Very little other equipment** is currently available and/or powered.



Source: SEforALL Project - Integrated Energy Planning (IEP), October 2023; Project LEAD World Bank - Field surveys for 1,189 CSBs, summer 2022; Database provided by DEPSI, November 2023

Electrification status of CHRDs

All CHRDs have access to electricity due to the equipment used, but access is mainly off-grid and often inadequate

CHRD ELECTRIFICATION STATUS

CHRDs normally **all have access to a minimum power supply**. However, they face **very limited access** with numerous power cuts. The daily availability of electricity can vary from 1-2h per day to around 16h per day, **depending on the reliability of the power source**. A more reliable power supply would greatly improve the health services provided to the population.

THE DIFFERENT SOURCES OF ELECTRICITY

- JIRAMA Grid
- Private mini-grid
- Solar plant
- Generator

N.B.: most CHRDs have a mix of several of the above electricity sources to increase the number of hours of supply.

According to information from DEPSI, **around 50% of CHRDs are connected to JIRAMA**. Unfortunately, data on other sources of power (individual solar plants, generators) are not available.

CHRD Betafo - Generator set provided by GIZ

CHRD Vatomandry - Small solar plant for the laboratory

CHRD Brickavile - Connection to JIRAMA grid

CHRD Vatomandry - Solar plant (charge controller, inverter and battery)

Source: MSanP interviews, SEforALL/PHC field visits, MSanP/DEPSI database (November 2023)

Advantages and disadvantages of different power sources

POWER SOURCE	ADVANTAGES	DISADVANTAGES
JIRAMA national grid (mainly heat engine-based mini-grids (MGs))	• Possibility of connecting more powerful equipment • No power generation and battery storage equipment to be maintained	• Frequent power cuts
Private MGs	• No generation and storage equipment to be maintained, since centralized at MG level • Technician usually on site for repairs	• Monthly bills payable to the MG operator • Possible outages if MG has insufficient capacity
Stand-alone solar PV plant	• No monthly invoices • Robust, 24-hour power supply if properly sized and maintained	• Operation and maintenance must be carried out • If undersized, rapid battery failure and deterioration
Generator	• Electricity available on request if fuel available • No storage (e.g., batteries) to be maintained	• High operating costs • Greenhouse gas emissions • Noise pollution • Dependence on fuel, which is difficult to access in remote areas

Source: SEforALL/PHC field visit

Favourable but sector-specific policy and regulatory framework implemented by the government

AN INCLUSIVE VISION HAS YET TO BE DEFINED (APPENDIX D)

HEALTH

- *National Health Policy* – reference for all health and health-related stakeholders and initiatives
- *Health Sector Development Plan* – PDSS (2020-2024)
- *Norms and standards for CSBs* (1 and 2) (2017) but little attention to electrical aspects
- *Norms and standards for CHRDs* (1 and 2) (2017) but not on electrical aspects

LOCAL DEVELOPMENT

- *Order no. 9438/2018* including, in particular, the payment of allowances to CSB dispensing agents and security guards
- *Decree no. 2017-014 restructuring the Local Development Fund as a National Public Administrative institution: a national system for financing investments in Decentralized Territorial Authorities*
- Reform of the *National Plan for Emerging Decentralization* (PNDE), in particular the financial allocation for CSBs

ENERGY

- *New Energy Policy (NPE)* (2015) including access to sustainable modern energy for 70% of households and 85% electricity generation using renewable energies by 2030
- *Law 1998-032 then 2017-20 on the Electricity Code in Madagascar - CODELEC* including liberalization of the energy sector - and certain amendments in March 2023
- *Decree no. 2002-1550 creating the Rural Electrification Development Agency (ADER)*
- *Law no. 2017-021 reforming the National Electricity Fund (FNE)* to promote RE and EE in rural areas
- *General Tax Code* including VAT exemption for import and sale of RE materials/equipment[1]
- *General Tax Code* including income tax reductions for investments in renewable energies

Source: MSanP, MEH, MID - RE: Renewable Energy; EE: Energy Efficiency

Limited or sometimes non-existent inter-ministerial coordination and cross-sectoral, multi-stakeholder coordination

INTER-MINISTERIAL COORDINATION

- There is currently **no formal coordination platform for the health-energy nexus** / electrification of HF. Exchanges and coordination therefore take place on an ad hoc basis, driven by specific needs.
- However, each ministry or agency **has links** with at least one other ministry or agency. For example:
  - The MEF allocates a budget line for the MSanP budget.
  - The MID grants subsidies for the running costs of municipalities and therefore also for the HFs of those municipalities.
  - For the electrification of certain departments at the CHRD in Betroka, MSanP, ADER and UNDP worked together to select the 5 priority services to be electrified, the electricity requirements and the sizing of the stand-alone solar plant.

CROSS-SECTORAL, MULTI-STAKEHOLDER COORDINATION

Government/ Public sector

TFP/NGO

Private sector

Other
Research, etc.

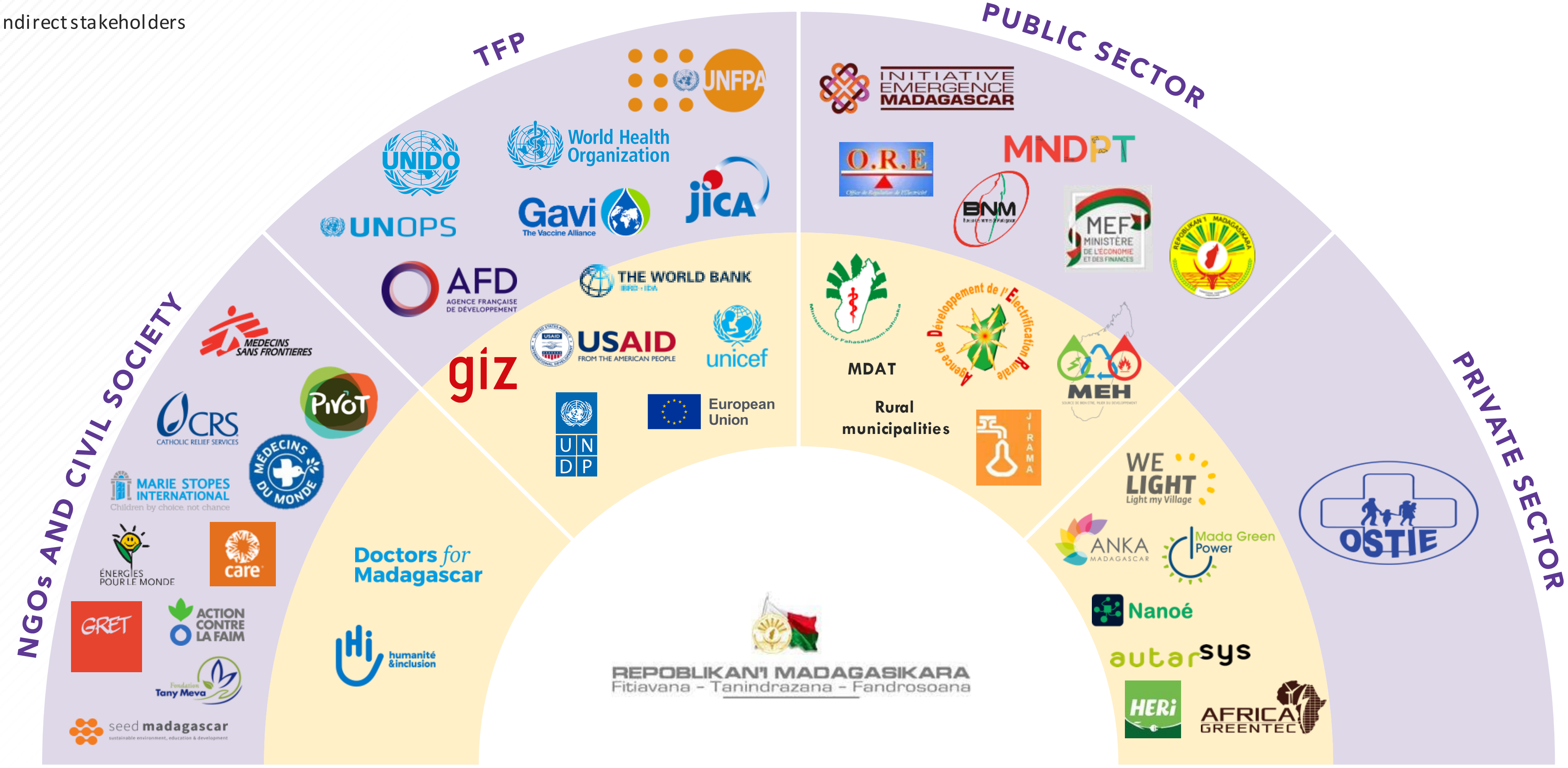
- **Feedback from** key stakeholders and SEforALL field visits has shown that due to a lack of coordination between different stakeholders, HFs in some villages experience:
  - Duplication of electrification work.
  - Some HFs benefitted from support in terms of medical equipment from several donors, while other neighbouring HFs had no such equipment.
  - TFPs and NGOs often have a limited sectoral approach: electrification of HFs but no refurbishment of buildings or acquisition of basic medical equipment.
- This coordination could be extended to all social infrastructures (such as schools) as well as to other public (CHRR and CHU) and private HFs (run by NGOs and the private sector).

Stakeholders operating in the health-energy nexus

Most of these stakeholders were consulted throughout the project. A more detailed list can be found in Appendix B

Level 1 - direct stakeholders

Level 2 - indirect stakeholders

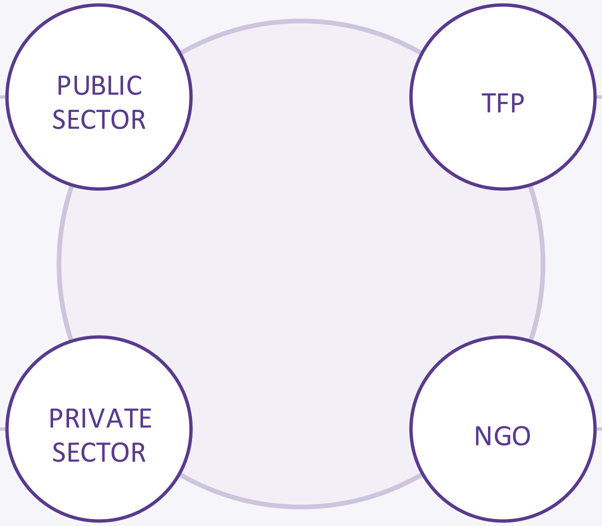


Specific roles of 4 categories of key players, with some synergies between players and interventions

ROLES OF EACH CATEGORY OF PLAYER

- Favourable policy and regulatory / environmental framework
- Management of the health information system
- Databases and statistics for both sectors
- Coordination of interventions
- Monitoring and evaluation

- Formulation and implementation of current and future interventions
- Technical assistance for other players
- Financial support (including investment)
- Monitoring and evaluation



- Understanding of the economic, geographic and social challenges of the healthcare and electrification sectors
- Technology solutions
- Profitability and sustainability of business models
- Access to financing
- Support for TFP/NGO project implementation

- Technical assistance for end beneficiaries
- Equipment donations
- Facilitating access to financing

Several efforts made by players to electrify HFs, but largely siloed approach

SITUATION

- **Numerous initiatives have been launched** regarding the electrification of HFs, involving **all key categories of players:** public sector/Malagasy government, TFPs, NGOs, private sector, etc.
- Most CSB electrification or back-up solutions for CHRDs are **stand-alone solar plants.**
- The **World Bank is implementing the largest projects in the field**, with plans to electrify a total of 1,500 CSBs (i.e. more than half of all CSBs) across the country via the LEAD (500 by June 2024) and DECIM (1,000 by March 2028) projects using stand-alone solar plants.
- The **development of private mini-grids** - via ADER APs and financed by various donors including SEforALL EUF[1] project or the EIB - can **include the connection of HFs.** In some cases, such as the APs supported by the EU/AFD, this is compulsory for social infrastructures, including HFs.
- Work to electrify HFs **depends largely on TFPs, particularly in terms of CAPEX.** Several **energy audits and feasibility studies** have been carried out, ranging from HF level to national level (e.g., energy audit of 1,189 CSBs across the country by WB LEAD project).

CONCLUSIONS AND GAPS

- Interventions **continue to focus on the electrification of healthcare facilities, with a siloed approach that** fails to take into account the general improvement in the quality of health services for the population, including appropriate medical and non-medical equipment, sufficient numbers of well-trained staff whose well-being is assured, etc.
- Current interventions do not appear to support the Malagasy government in **developing clear planning and prioritization of HFE.**
- **Coordination and synergies** between interventions in the health and energy sectors are still **very limited**, but interest in the "health-energy" nexus is growing. SEforALL and the PHC project have therefore set up a multi-stakeholder working group for this purpose, which will continue after the end of the project.
- There is **no real business model to ensure the sustainability** of HFE efforts, particularly after the end of the project and in relation to the financing of HF electricity needs (OPEX or electricity bills).
- The role of the private sector is too often limited to the design, purchase and installation of energy solutions, whereas the private sector would like to extend its role over the long term, in particular via O&M for stand-alone systems (as with mini-grids).

(1) UEF: Universal Energy Facility - offering a results-based financing mechanism for private MG operators.

Summary of main interventions (ongoing and completed)*

* A more exhaustive list can be found in Appendix C

TECHNICAL AND FINANCIAL PARTNERS / NGOs

THE WORLD BANK	• LEAD: electrification of 500 CSBs (47 completed, 453 by June 2024) • DECIM: electrification of 1,000 CSBs (project launched in July 2023)
unicef	Refurbishment and electrification of CHRDs and CSBs in 5 regions and 10 districts - EUR 9M
giz	PERER/Fonds COVID BMZ: electrification of 8 CHUs, 4 CSBs II and 6 CHRR-Ds (completed)
USAID / POWER AFRICA	Southern Africa Energy Program (SAEP): electrification of 35 CSBs with 3 private operators (completed)
UNDP	Africa Minigrids Program (AMP) Madagascar: electrification of specific facilities in 2 CHUs, 2 CHRRs, 1 CHRD
European Union / European Investment Bank	• Rural electrification through concessions including HFs via AFD with ADER • Co-investment in electrification of 120 villages in 17 regions via WeLight, including HFs
Doctors for Madagascar	Electrification of 50 CSBs in the south (5 completed)[1]

PRIVATE SECTOR

Projects with a **focus on HFE:**

ANKA Madagascar, Doctors for Madagascar	Electrification of 50 CSBs with NGOs (5 completed)
Nanoé, autarsys, HERi	Electrification of 35 CSBs with (completed) USAID / POWER AFRICA
Mada Green Power	Electrification of 14 HFs with giz

Village electrification, **often including HFs for local operators:**

WE LIGHT (Light my Village)	Electrification of 171 villages, including 167 CSBs (15 CSB already electrified out of 22 operational MG)
ANKA Madagascar	Electrification of 104 villages including 91 CSBs by MG (14 CSBs already electrified out of 14 MG operational)
AFRICA GREENTEC	Electrification of 7 villages including 6 CSBs by MG

Source: Interviews with stakeholders, GIZ, Power Africa; (1) CSB seeks funding on a CSB-by-CSB basis, therefore no predefined timetable

The World Bank's LEAD and DECIM projects are good examples of HFE in Madagascar

THE WORLD BANK

LEAD PROJECT (ongoing and until 6/24)

1st phase (2020)	47 electrified CSBs
2nd phase (in progress)	453 CSBs to be electrified by June 2024
Geographical coverage	CSBs throughout the country


CSB2 Ambohimasina


CSB2 Tsiafajavona

FEEDBACK FROM SEforALL (LEAD) FIELD VISIT

Two healthcare facilities electrified by the LEAD project were visited by the TTA-AIDES consultancy teams for SEforALL. Their main findings are set out below:

- Solar power plants supply electricity **reliably** and in sufficient quantities **for current needs**
- Healthcare facility **staff satisfied**
- Compliance with **electrical standards**
- The operation and maintenance carried out by the installer seem to be working well. However, there is a real **concern** among CSBs about the **management of the solar plant once the 3-year O&M period is over**
- At present, apart from lighting, there is **very little electrical equipment available, which limits the overall impact on health services**

OBJECTIVES : use roadmap recommendations for future electrification projects

DECIM PROJECT (Started in July 2023)

OBJECTIVES	**1,000 CSBs to be electrified**
2nd phase (in progress)	Other components include access to digitalization and electrification of other public structures
Geographical coverage	CSBs throughout the country

Source: SEforALL/PHC field visits

Photo credit: Associated Press

CHAPTER THREE

Current and Future Challenges

Current and future challenges, and recommendations to overcome them

1 2

MAJOR CHALLENGES	RECOMMENDATIONS		
	DESCRIPTION	DEADLINE[1]	LEVEL
ELECTRIFICATION PLANNING IS DIFFICULT			
Poor knowledge of electrification status **An exhaustive, non-consolidated database**	Update electrification status and standardize data via DB consolidation through SEforALL's PHC and IEP projects	1st half of 2024	National
Little visibility of future equipment and uses	Include and plan medical and non-medical equipment in the roadmap for sustainable electrification of HFs	2nd half of 2024	National
Limited coordination between key players	• Draw up a list of current and future interventions (to be updated regularly) to better share information and ensure greater synergies between electrification interventions and, in particular, the supply of medical equipment • Better coordination and planning via the consolidated database • Sustain the health-energy nexus working group created by the project	1st half of 2024	National
OPERATIONAL CHALLENGES			
Lack of standards for HFE **Lack of dedicated personnel trained in electrical aspects**	• Define electrical standards for HFs for all interventions, to be added to CHRD and CSB standards. • Capacity-building at local (HF) and regional (MSanP) levels	Late 2024 - early 2025	Local and regional
Buildings often unsuitable or in poor condition	Take into account the structural integrity of the building for solar panels on roofs, or install them outside existing buildings (on roof of future waiting room, on the ground, etc.).	1st half of 2024	National
Medical equipment often inadequate	Adopt a more integrated and coordinated approach between stakeholders to improve health services for populations (of which electrification is a pillar), particularly access to medical equipment.	Late 2024- early 2025	National/ International

(1): Preliminary dates - to be confirmed during phase 1 of the roadmap.

Current and future challenges, and recommendations to overcome them

1 2

MAJOR CHALLENGES	RECOMMENDATIONS		
	DESCRIPTION	DEADLINE[1]	LEVEL
LITTLE CONSIDERATION OF SUSTAINABILITY			
A lack of profitable, sustainable business models	Test how to secure reliable sources of revenue, optimize costs, improve HR skills, check the desire to obtain electricity	Late 2024- early 2025	Local
Difficult to finance O&M and even consumption	• Identify existing and possible sources of funding to cover the OPEX of models based on stand-alone solar plants • Consider various possible solutions for paying for electricity from private operators and/or having a private operator carry out O&M activities for the HF	1st half of 2024	All levels
Limited existing sources of financing	Consider alternative sources of financing, some of which have already been implemented in some HF	2024-2026 depending on source	All levels
Market distortion due to CAPEX coverage	Encourage private-sector participation and innovation in the sustainable electrification of HF, with specific, targeted involvement of TFPs	2024-2026	National
LITTLE CONSIDERATION OF VULNERABLE GROUPS			
Challenges compounded by limited access to electricity in rural areas **Limited access to drinking water and hot water in HF**	Take better account of the specific needs of vulnerable populations, particularly as regards cold chain and clean/drinking water	2nd half of 2024	National
LACK OF INTEGRATED APPROACH			
A siloed approach limiting the improvement of healthcare services	Adopt an integrated approach to improving health services, of which electrification is only one piece of the puzzle	2nd half of 2024	National

(1): Preliminary dates - to be confirmed during phase 1 of the roadmap.

CHAPTER 3.1

Challenges in electrification planning

SUMMARY

Poorly-known electrification status

An exhaustive, unconsolidated database

Little visibility of future equipment and uses

Little visibility of future equipment and uses

Limited data on actual status of electrification and also limited access to detailed data relevant to all HFs

As indicated in the previous chapter, the consolidated DB is based on the **external data** collected and the 15 HF visits carried out as part of the PHC project

ELECTRIFICATION STATUS

There are a number of different cases in the databases we collected:

- No energy-related data available
- No information on electricity source (JIRAMA, MG, stand-alone solar plant or any other energy source)
- No information on whether the HF has a solar refrigerator with a solar panel
- No information on whether the power source(s) is/are operational today (e.g. faulty panel, etc.).
- No data on actual electricity consumption

As of the time of writing, none of the databases collected indicates for all CHRDs and CSBs whether there is access to electricity, whether it is operational and what the actual consumption of each HF is.

Source: Analysis of the various databases collected

AVAILABLE DATA

The data collected are **very heterogeneous** in terms of:

- **Type of data collected**
  - Sometimes only a list with the names of villages where a CSB/CHRD is located, and GPS coordinates
- **Granularity**
  - The LEAD project's energy audit of 1,189 CSBs provides detailed information on human resources, specific electricity requirements, etc. Other DBs indicate only the number of staff
- **Date of last data update**
  - Some DBs are static (audits), others dynamic but not always regularly updated

RECOMMENDATION

The **database consolidation** achieved by the PHC project is an **opportunity to define an effective strategy for dynamically updating electrification status and standardizing the data available for all HFs**. A single key and telemetry in each electrified HF will be invaluable tools.

Limited knowledge about available medical and non-medical equipment and its usage

EQUIPMENT PLANNING

- Planning is carried out via an annual work plan (AWP) with activities and costs that each municipality and district prepares and that includes the CSB and CHRD, respectively.
- The share of the health budget in the state budget was around 6.7% in 2020, well below the Abuja Declaration level of 15%.
- More than 80% of the healthcare budget is allocated to operating costs, which leaves little room for investment, especially in equipment.
- According to a USAID study, TFPs finance 63% of capital expenditure. USAID is the largest donor in Madagascar's healthcare sector, particularly for medical equipment and materials.
- The state budget allocated to CHRDs (through the district) and CSBs (through the municipality) is paid in 2 instalments - before April 30 and before October 30, and includes budget lines for medical and non-medical equipment.

RECOMMENDATION

Including medical and non-medical equipment and planning in the roadmap is essential

SITUATION

CSB

- As of today, a project is underway to provide a "minimum activity package" for CSBs, including the cold chain aspect. Universal access for CSBs to a **solar refrigerator** is under way. UNICEF and GAVI are among the biggest contributors.
- **No current plans to supply sterilizers or lighting equipment.**
- During field visits, some CSBs mentioned that they had not benefitted from AWPs since 2018.

→ *Standards for minimum activity package not always complied with*

CHRD

- A **wide disparity** in available and operational **equipment** from one CHRD to another.
- In 2024, a project will be launched to ensure that every CHRD has a solar refrigerator.

→ *Standards for additional activity package not always complied with*

Source: UNICEF, USAID, SEforALL field visits

Current lack of coordination between key players

Lack of formal **inter-ministerial coordination** in respect of the health-energy nexus

Lack of **cross-sectoral and multi-stakeholder coordination** (government, TFPs, private sector, etc.)

01 **Lack of overview of electrification and actual electrification status of HFs across the country** and difficulties in monitoring, which can create geographical disparities and some inefficiencies in interventions at national level.

02 The energy needs of HFs are taken into account in different ways, resulting in **different electricity system capacities –** some do not adequately meet needs, while others are oversized.

03 **Standards** for types of electrical equipment **vary between stakeholders** (not homogeneous, as there are no national standards).

RECOMMENDATIONS

A list of current and future interventions in the health-energy nexus in Madagascar should be drawn up.

A **consolidated database** of all CHRDs and CSBs, with information on electrification (where applicable) and other key criteria for electrification is needed

→ Via the PHC project and included in IEP mapping

A **health-energy nexus working group** set up by the PHC project, bringing together key ministries and public agencies as well as TFPs. This working group should be institutionalized as part of the roadmap, and key private sector players should be consulted if necessary.

CHAPTER 3.2

Operational Challenges

SUMMARY

Lack of standards for HF electrification

Lack of dedicated personnel trained in electrical aspects

Buildings often unsuitable

Medical equipment often inadequate

Lack of local electrification standards and skills resulting in widely differing and often inadequate installation quality

Electrical installations that do not always comply with standards for the protection of people and buildings (see photos from CSB and CHRD site visits).

Electrical systems sometimes not used as intended: for example, lighting connected directly to the solar panel for the solar refrigerator, batteries used for the mayor's personal needs, etc.

There are no electrical standards in the CSB and CHRD standards defined by the MSanP. Each stakeholder is therefore free to install the electrical system using the standards they consider most appropriate.

Local electrical expertise is limited to HF staff members. There is no one person dedicated to electrical and technical aspects. In CHRDs, however, there may be a "handyman" responsible for caretaking, maintenance, gardening and technical aspects.

HFs are currently already **understaffed**, and **some staff are close to burn-out**, so it would be difficult to ask them to take on additional duties (e.g. electricity).

RECOMMENDATIONS

Electrical standards for CSBs and CHRDs to be defined for **all interventions,** then **added to CSB and CHRD standards**

Local capacity-building for 2-3 people and **regional capacity-building** via MSanP (including training of trainers)

Source: SEforALL/PHC field visits

Buildings often old and in poor condition

SEforALL/PHC FIELD VISITS

- The CSB and CHRD buildings visited during the project were **built between 1910 and 1980**
- 50% of buildings are **in poor condition** (even dilapidated, as shown in the photos on the left)
- Buildings face **difficult climate conditions**
- In general, **no building extensions are planned** in the HFs visited
- The buildings are mainly of **brick construction with tin roofs**
- The CSBs and CHRDs visited do not generally have **a waiting room**, but more than half would like one

> *In the east of the country, which suffers numerous storms and cyclones* **every year, roofs are blown off and part of the HF buildings are destroyed**

RECOMMENDATIONS

For stand-alone systems **on a roof, the structural integrity of the building** must first be ensured.

Alternatively, **consider installing stand-alone systems outside buildings.** Building an outdoor waiting room with solar panels can be a double-impact solution, or installing panels on the ground.

Source: SEforALL/PHC field visits, bilateral interviews

Limited availability of medical and non-medical equipment

SITUATION

- The low population density in some of the country's rural areas, in spite of numerous villages, leads to a **dilution of medical and non-medical equipment and resources.**
- The **MSanP has a limited budget**, particularly for medical and non-medical equipment for HFs.
- At municipality level, the HF has to cope with the **often insufficient allocations from the municipality for equipment**. The allocation for an HF furthermore includes its operating costs.
- **NGOs supply equipment that is certainly very useful** but which can have heterogeneous specifications, be more or less modern (second-hand), of different brands, for which it is not always easy to source particular spare parts, and for which on-site maintenance can quickly become complicated. As a result, some equipment that has become defective stays on site and is of no use.
- During the **COVID-19 pandemic and in the post-COVID period**, several interventions were implemented by various TFPs, in particular relating to cold chain for vaccines, for example UNICEF and GAVI, which provided solar refrigerators in CSBs.
- HFs, in particular CSBs, **heat water with whatever they have at hand**, such as camping stoves, etc.

TESTIMONIALS FROM HF DOCTORS

> *We are sorely lacking in some basic equipment. **Some midwives have invested in their own mobile ultrasound machines**, which they bring to the CHRD.*

> *We have a **gas autoclave sterilizer** in our CSB and **use it 1-2 times a week** due to time constraints.*

> *We finally got some of the equipment we had been requesting from MSanP for quite some time, after the **Minister's visit!***

> *A **good understanding between the chief medical officer and the mayor** is a positive factor in covering the needs of HF.*

RECOMMENDATION

A **more integrated approach** (equipment, electrification, etc.) **and greater coordination** between the key stakeholders advocated by this roadmap will help to improve **health services for the population**. In particular, it is important to consider access to equipment.

Source: Bilateral interviews, SEforALL field visits

CHAPTER 3.3

Challenges for Sustainability

SUMMARY

Lack of profitable and sustainable business models

Difficult to finance O&M or even consumption

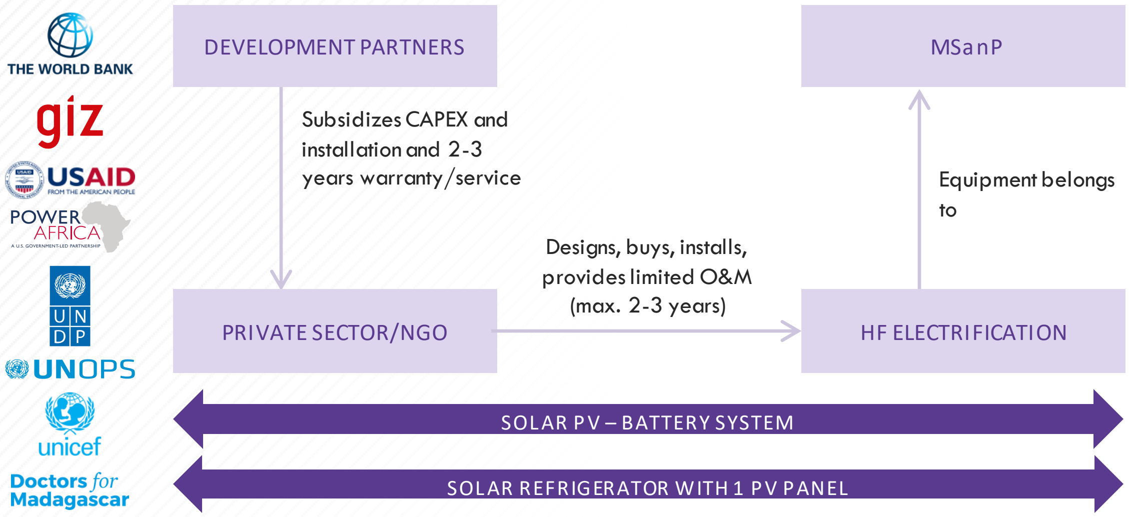
Existing sources of finance are limited

Market distortion due to full coverage of CAPEX costs

The two business models for off-grid JIRAMA electrification in the CBS and CHRD structures

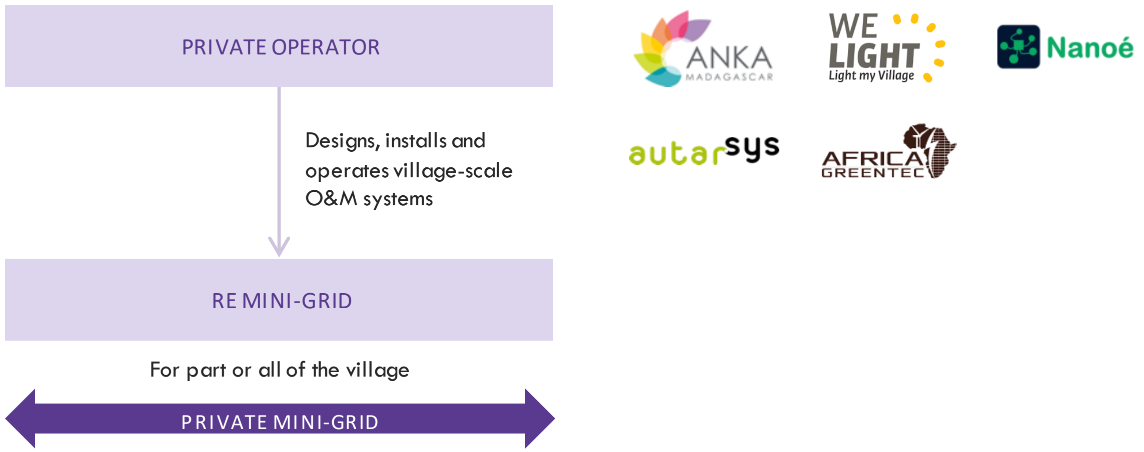
BUILD – OPERATE – TRANSFER (BOT)

MOST COMMON



- This model is implemented when the CSB has **no access to electricity, as a back-up or complementary solution for a CHRD, or sometimes when a private mini-grid exists.**
- In this model, there is no monthly bill to be paid by the HF, but it must cover the **costs of operation, maintenance and replacement of components/ equipment.**

ENERGY-AS-A-SERVICE



- **If the CSB is not electrified,** the private operator connects it to its mini-grid and the HF pays a **monthly bill.** The private operator takes care of OPEX and the replacement of components/equipment on its mini-grid.
- The private operator may cover the connection fees (like WeLight) or part of the HF's monthly bill (which may be a "bad payer") is offset by the bills paid by the village's high-end MSME consumers (cross-subsidies).

Source: SEforALL field visits, project working group, bilateral interviews; (*) The logos indicate the stakeholders involved in each business model in Madagascar (non-exhaustive list).

These two business models are neither profitable nor sustainable

Low long-term O&M financing

- Limited funding for OPEX and equipment/parts replacement
- HFs have low ability to pay for electricity
- Dependence on budget allocation by the municipality (via MID)

Insufficient medical and non-medical equipment

- HF underequipped in relation to standards
- Systems often oversized, with high OPEX and replacement costs
- Connectivity/internet not always guaranteed, but is essential for data, statistics and telemedicine
- Access to drinking water and hot water often neglected, yet critical for hygiene
- Equipment donated by NGOs, etc. without control, so spare parts and maintenance are difficult

Lack of effective and impactful planning

- Buildings are often dilapidated and have roofs that are not robust enough to accommodate stand-alone solar solutions
- Electrification of HF not based on objective criteria and priorities

No local skills

- Lack of staff training for basic maintenance of solar PV systems

N.B.: furthermore, the electrification business model can only work if the HF itself works well (sufficient number of patients, trained staff, etc.).

RECOMMENDATION

To ensure the profitability and sustainability of business models for electrifying HF, **cost optimization, revenue requirements and human resource skills** at HF level are key considerations, along with other factors such as the HF's motivation and desire for access to electricity.

Medium and long-term challenges due to O&M and equipment replacement for stand-alone solar plants

Build-Operate-Transfer (BOT) model

In this model, OPEX is linked to the following costs:

OPERATION & MAINTENANCE (O&M)

The aim is to maintain the stand-alone plant so that it can operate properly over the long term. These costs are largely covered by the HF. This also includes the replacement of components such as fuses or bulbs.

TECHNICAL STAFF AND DIGITIZATION

For O&M, staff capable of carrying out these activities are needed, including basic maintenance at local level. Staff can be supported by a telemetry system to ensure monitoring (including alerts in the event of breakdowns, etc.) of the stand-alone plant. Digitization can also share indicators and data on medical services and HF management, or facilitate telemedicine.

EQUIPMENT REPLACEMENT

Equipment such as the battery or inverter will have to be replaced over the 20+ year life of a stand-alone system.

SITUATION

The TFPs and NGOs supporting the electrification of HFs in Madagascar finance the CAPEX and also, depending on the project, 2 to 3 years of OPEX as shown below.

However, after these 2-3 years have elapsed, OPEX are no longer covered, and the CSBs and CHRDs are unable to cover these costs given their current financial situation.

O&M and equipment replacement would amount to at least USD 1,500 per year, with replacement costs varying according to system sizing. Further details are provided in the roadmap section (Chapter 4).

RECOMMENDATION

The different **existing and potential sources of funding** to cover the OPEX of this model over the medium and long term must be identified.

Profitability of private mini-grid threatened by a CSB's reputation as a "bad payer" due to low consumption and solvency

Energy-as-a-Service model (EaaS)

Monthly bill or prepayment	• The CSB, like any other user of the mini-grid, must pay a **monthly bill based on its consumption of electricity/kWh** (plus its fixed monthly fee) or by prepayment (via top-up of a given amount). • In the case of private mini-grids, **the operator must pay a local tax to operate in the village.** This tax is normally used to cover the costs of street lighting and potential grid expansions. • In practice, however, monthly invoices are not necessarily paid, so some operators **withhold tax to cover their costs.**
Operation & Maintenance (O&M) Technical staff and digitization Equipment replacement	• **These costs are fully borne by the private operator** and passed on in the per-kWh fee charged to public and social institutions such as HFs.

RECOMMENDATIONS

Various solutions could be considered to ensure payment for electricity, such as: preferential fee per kWh, no monthly fee, prepaid meter, PAYG (leasing), CSB endowment and municipal tax.

In the case of a CSB already electrified by a stand-alone solar plant, the mini-grid operator **could cover part of the O&M costs of the stand-alone solar plant** in exchange for re-injection of electricity generated by the CSB.

Source: Bilateral interviews

Limited financing sources for HFs, already used for specified purposes

IDENTIFIED FINANCING	FUNDER	CAPEX THAT CAN BE COVERED	OPEX THAT CAN BE COVERED
Budget line in Finance Act for MSanP and HFs (credit allocations)	MEF	✔ Equipments	✔ Salaries of public-sector medical staff
Operating subsidies from municipalities including HFs • The HF provides an annual work plan (AWP) with budget • A management committee (CoGES) allocates funds on the basis of the AWP	MID/ Municipality	✔ Minor maintenance, cleaning, repairs	✔ Electricity and water quotas included per HF
Subsidy for security guard and dispensing agent compensation • Contribution to security guard and dispensing agent salaries	MID/ Municipality	✘	✔
Municipality's own resources allocated via the CoGES • Covers the remainder of the security guard's salary, and that of the dispensing agent • To be defined on a case-by-case basis	Municipality	✘	✔
CSB allocation (Decree no. 2019-2117) • As part of the Madagascar Emergence Initiative • Plenty of discussion, including about electricity and water	MSanP via MEH	✔ Purchase of minor equipment	✔ Minor maintenance, cleaning, repairs
Local Development Fund (FDL) • To support local investments according to particular criteria	MDAT	✔ Part of the CAPEX for electrification could be covered	✘
NGO donations	ONG	✔ Medical and non-medical equipment	✔ Technical assistance including capacity-building
TFP projects and programmes • Electrification, refurbishment/construction, medical and non-medical equipment, digitalization	PTF	✔ Investments	✔ Technical assistance including O&M, capacity-building

SITUATION

- The financing sources used by HFs' target specified expenses.
- They are not used for O&M costs or replacement of electrical equipment, except in the case of TFPs and NGOs, and are still limited in time (2-3 years).
- These sources of financing are already insufficient to cover needs such as medical equipment or personnel.

RECOMMENDATION

Alternative sources of financing need to be considered, **some of which already exist but need to be further explored,** such as the LDF or the lobbying potential of regions, and others that are marginal or innovative, such as income from non-medical services (telephone charging or printing/photocopying).

Source: Bilateral interviews, project working group, stakeholder consultation workshop

Market distortion caused by CAPEX costs

IN MADAGASCAR, ALTHOUGH COVERING THE CAPEX COSTS IS NOT A CHALLENGE, IT CREATES SOME MARKET DISTORTION

CAPEX

There is currently **heavy dependence on TFPs** for HFE CAPEX

- Contracts with private operators for the design, purchase and installation of stand-alone solar PV plants
- Grants and loans (including RBF and concessional loans) for private mini-grid operators

ADVANTAGES

Stimulating demand for stand-alone solar plants and other electrification solutions. This increased demand can attract private sector investment and encourage innovation.

Lower financial risk by partially covering CAPEX, which can encourage private-sector investors to enter the market.

Capacity-building included in PTES interventions helping to develop the local skills needed to support a sustainable HFE market.

DISADVANTAGES

Excessive dependence on TFPs can create a situation in which the private sector becomes dependent on these funds and is less motivated to invest its own resources. This can lead to a lack of long-term sustainability.

Potential price distortion, preventing private operators from being competitive and making the market less efficient.

Discouraging private investment if TFP-financed projects are seen as a more attractive option for HFs, as they do not have to pay up-front costs for electrification.

RECOMMENDATION

It is important to find sustainable solutions that do not require ongoing TFP support, that involve the private sector to a greater extent, and to ensure that TFP funding is allocated transparently and competitively to encourage private-sector participation and innovation.

CHAPTER 3.4

Challenges for Vulnerable Groups

SUMMARY

Challenges compounded by limited access to electricity

Limited access to drinking water/hot water in HFs

Needs of vulnerable populations

Vulnerable populations are particularly affected by limited access to electricity in HFs, especially access to drinking water and hot water

VULNERABLE POPULATIONS

- Children aged 0-5
- Pregnant and nursing women
- Young people aged 15-24
- Isolated rural populations

MAIN CHALLENGES

- **Vaccination coverage for children under 5**

A reliable, high-quality cold chain is essential to ensure vaccine quality and reduce drop-out rates after initial doses.

- **Prenatal consultation**

Improving the management of prenatal consultations is also an important objective. This includes the use of ultrasound scanners and the introduction of a cold chain for storing vaccines and tests.

- **Maternal and newborn mortality**

Lighting at night is essential to ensure quality deliveries, but a weak cold chain limits access to certain essential drugs such as oxytocin.

FOCUS ON WATER

- **Gastrointestinal diseases**

Children, especially sick children, are more vulnerable to gastrointestinal illnesses. (Very high rates among children in the country).

- **Caring for malnourished children**

For the preparation of paediatric milk.

- **Nosocomial diseases**

Access to clean water is also important to prevent hospital-acquired infections.

- **During childbirth**

The use of clean water for the various stages of childbirth is particularly important.

RECOMMENDATION

It is crucial to take into account the specific needs of vulnerable populations, particularly in terms of cold chain and clean/drinking water

Source: Health Sector Development Plan (PDSS) 2020-2024 / MSanP; Multiple Indicator Cluster Survey (MICS), UNICEF, 2018; Energizing health: accelerating electricity access in healthcare facilities, WHO, 2023

CHAPTER 3.5

Challenges in Integration

SUMMARY

A siloed approach limiting the improvement of healthcare services

Limited coordination

Despite numerous efforts by stakeholders, the siloed approach limits the impact on the overall, sustainable improvement of healthcare services

INTERVENTIONS REGARDING CSBs & CHRDs

LITTLE OR NO COORDINATION AND SYNERGIES BETWEEN AREAS

- Electrification
- Equipment
- Refurbishment/Construction
- Capacity-building
- Digitization

Etc.

HEALTH INDICATORS IN MADAGASCAR REMAIN RELATIVELY POOR:

- Infant mortality rate has remained at 45 deaths/1,000 live births since 2015
- Life expectancy deteriorated in 2021 to 64 years, back to 2012-2015 levels
- Only 41% of children aged 12-23 months have received all basic vaccines
- Only 38.5% of deliveries take place in a HF

RECOMMENDATION

The roadmap therefore proposes **adopting an integrated approach to improving healthcare services** - of which HFE is an integral part - rather than focusing solely on sustainable HF electrification

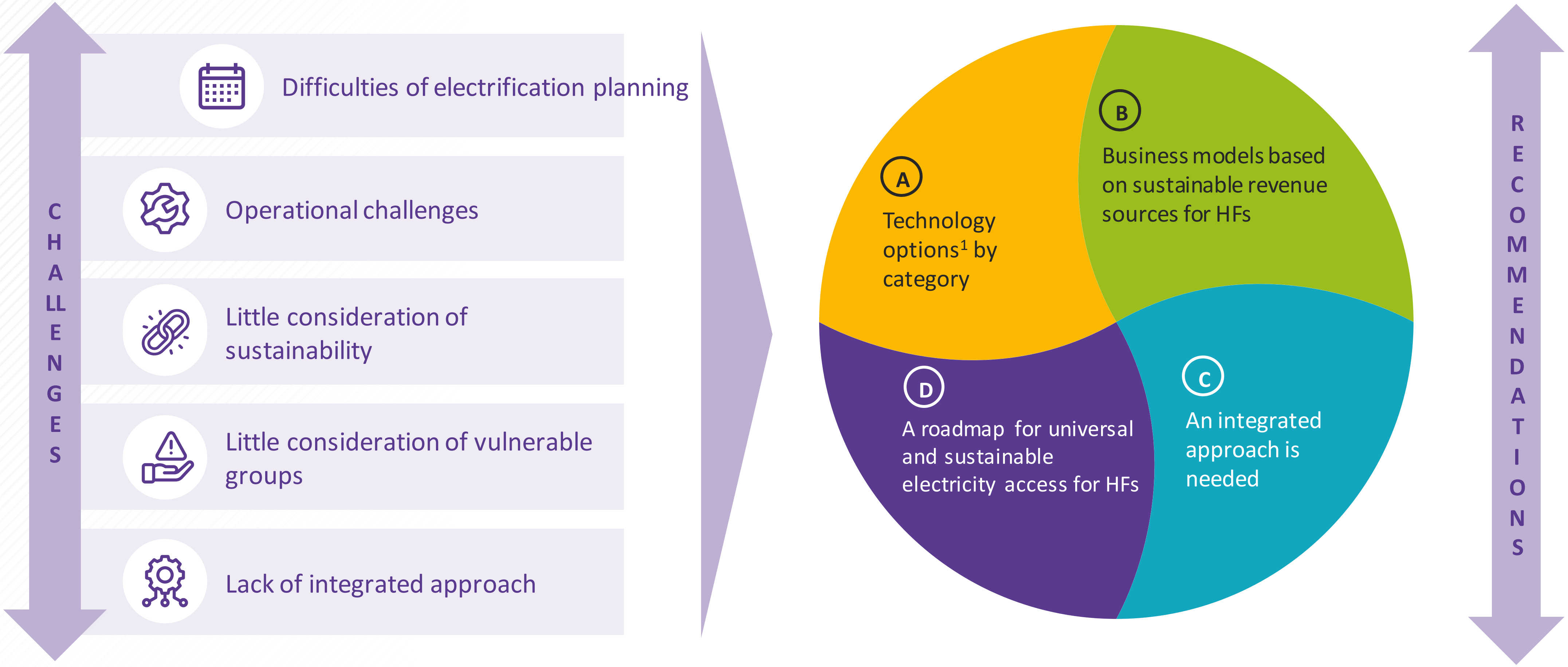
Source: World Bank Open Data, UNICEF, Demographic and Health Survey (EDSMD-V), INSTAT, 2021

CHAPTER FOUR

Solutions and Recommendations

4 categories of proposed solutions and recommendations

1 2 3 4



(1) For stand-alone power plants, solar has been chosen as the easiest and quickest solution (i.e. no need for a study of energy source potential vs. other RE) to deploy, with an attractive cost-benefit ratio and relatively low maintenance costs. For mini-grids, energy sources can be solar, hydro, wind or hybrid

4 categories of proposed solutions and recommendations

1 2 3 4

RECOMMENDED SOLUTIONS	DESCRIPTION	PERIOD[1]	LEVEL
A. TECHNOLOGY OPTIONS BY CATEGORY			
CSBs and CHRDs: 1 stand-alone solution and 1 back-up solution, both consisting of solar panels + battery, have been selected	• The main electrification solution (59%) is **stand-alone solar** (for all CSB or one/several CHRD departments). In addition, **back-up solutions to ensure continuity of electricity supply** (power cuts or ability to pay) if the HF is connected immediately or in the near future to the JIRAMA grid or to a mini-grid (MG). • **Investments must be prioritized**, including consideration of the HF's desire for access to reliable and sustainable electricity, as well as its current/future electrification status (e.g. whether the HF will soon be connected to JIRAMA or an MG).	2024-2032	National
CSBs: potential electrification market of 2,174 CSBs nationwide	• **Priority 1**: **CSBs that are isolated or far from a grid** (JIRAMA or MG) should all have **stand-alone solar** (estimated at 1,300 CSBs, of which 1,000 would be electrified by the WB's DECIM project by March 2028). • **Priority 2: 100% of CSBs connected to JIRAMA will need a back-up solution** to ensure continuity of service (particularly in the event of power cuts). • **Priority 3: 80% of CSBs connected to a private MG will have a back-up solution** to deal with any potential issues regarding the CSB's payment ability/solvency.	2024-2032	National
CSBs: solar plant installation must include electrical equipment	• The electrification of a CSB must **cover its basic needs.** • Thus, a **multi-dimensional solution** is required including: (i) generation and storage; (ii) medical and non-medical equipment (including LED lamps, sterilizers and tablets); and (iii) management (telemetry).	2024-2032	Local
CSBs: standardized technical solutions optimize CSB electrification	• The **sizing of** the solar plants has been developed **based on 4 main criteria**: (i) type of CSB (1 or 2); (ii) solar radiation according to location; (iii) electrification status (connected to JIRAMA, a MG, or isolated); (iv) attendance based on number of visits/month. • On this basis, considerations of **solar capacity** (4 options 1.2/2.4/3.6/4.8 kW) **combined with battery storage requirements** (3 options) could be considered. • Finally, **standard technical solutions covering the various possible situations and the associated CAPEX and OPEX have** been estimated.	2024-2032	National
CHRDs: energy audits are needed to define the right solution	• **Projections in terms of the estimated number of stand-alone or back-up solutions** have been issued for CHRDs, thanks in particular to projects already completed (GIZ and UNDP). • However, given the wide diversity of equipment present in each CHRD, and therefore of its electricity requirements, standard sizing cannot be established as it can for CSBs. **A case-by-case assessment will have to be carried out via energy audits for CHRDs.**	2024-2025	National

(1) Period depending on roadmap duration

4 categories of proposed solutions and recommendations

1 2 3 4

RECOMMENDED SOLUTIONS	DESCRIPTION	PERIOD[1]	LEVEL
B. BUSINESS MODELS BASED ON SUSTAINABLE REVENUE SOURCES FOR HFs			
Without OPEX funding, no business model will be sustainable	• **Various business models**, existing or otherwise, can potentially be considered for the electrification of HFs in Madagascar: Build-Operate-Transfer (BOT), Energy-as-a-Service (EaaS), Pico PV Pay-As-You-Go (PAYG) system, and hybrid models - all of which have their **advantages and disadvantages** in practice. • However, it is **vital for the sustainability of any business model to ensure that OPEX can be covered over the long term**: it is a *sine qua non*!	2024-2032	Local and national
Several conditions are key to adopting a sustainable business model	• The **sustainability and success of business models depend** in particular on: (i) improved payment ability/solvency of the HF over the long term; (ii) appropriate sizing; (iii) a HF that proves its motivation to be electrified (bottom-up approach) and that responds to national planning priorities (top-down approach); (iv) greater involvement of the private sector; (v) a more integrated and coordinated approach between key stakeholders; (vi) and targeted capacity-building.	2024-2032	Local, regional and national
HF solvency can be improved through revenues and cost optimization	• **Ensuring the HF's ability to pay over the long term,** which is the cornerstone of sustainable HF electrification, is crucial. • In addition, **various sources of income/financing** for HFs at the regional, national and international levels have been identified for Madagascar (some of which are already proven). • In addition, **optimizing specific costs such as training, EE equipment and telemetry** can support the sustainability of the business model.	2024-2032	All levels
C. AN INTEGRATED APPROACH IS NEEDED			
A shared goal – improvement of care	• **Electrification of HFs is just one of the key levers for** contributing to the sustainable improvement of healthcare services. • An **integrated approach** including other levers and the key stakeholders in all of these levers is required: provision of equipment; sufficient staff and staff welfare; training; digitization/telemetry; prioritization of investment according to impact; financial sustainability; HF refurbishment/construction; access to drinking water, etc.	2024-2032	All levels
Coordination of multi-stakeholders to be institutionalized	• It is essential to facilitate **synergies** between key players, ensure better **inter-ministerial coordination** and **perpetuate the** PHC project **working group.**	2024-2032	All levels
Multi-dimensional indicators to be defined and monitored	• The indicators for interventions in relation to HF electrification to be monitored need to adopt a more integrated approach, i.e., include not only technical indicators, but also operational (such as alarms) and health (what is the impact of electricity on the health services offered by the HF) indicators.	2024-2032	Local

(1) Period depending on roadmap duration

4 categories of proposed solutions and recommendations

1 2 3 4

RECOMMENDED SOLUTIONS	DESCRIPTION	PERIOD[1]	LEVEL
D. ROADMAP FOR UNIVERSAL AND SUSTAINABLE ELECTRICITY ACCESS FOR HFs			
A roadmap based on a bottom-up and integrated approach	• **Sustainable improvement of healthcare services (integrated approach) and HFs (bottom-up approach) are at the core of the roadmap.** • As indicated above, **the integrated approach includes various levers** for improving the health services provided to populations. • **The bottom-up approach** involves ascertaining the real needs of HFs and their desire to access electricity in order to improve the health services they provide. A system of **calls for projects aimed at HFs** could be put in place - MSanP's Regional Directorates could help HFs apply. This approach will be **complemented by a top-down approach** to integrate the planning aspects of HF electrification throughout the territory and the MSanP's prioritization criteria, coordination between key players and centralized monitoring.	2024-2032	Local, regional and national
A step-by-step approach	• The roadmap is broken down into **3 key phases from 2024 to 2032**: (i) Phase 1: Structuring and Cluster test; (ii) Phase 2: Demonstration and Implementation; (iii) Phase 3: Consolidation. The **cluster test** mentioned here involves considering at least 15-20 HFs to experiment with different business models, including revenue streams, as well as bottom-up and integrated approaches. The results of this test will be included in phases 2 and 3. • Each of the 3 phases is **described in detail** with its main activities and results.	2024-2032	All levels
A financing plan and fundraising to be developed	• The roadmap assumes **financing requirements of USD 52M CAPEX and USD 31M OPEX over 10 years** for the electrification of CSBs and CHRDs. • A **joint fundraising strategy** will be developed and implemented as part of the roadmap.	2024-2032	All levels
Key players with specific, synergistic roles	• The **clear roles of each stakeholder** will be defined as soon as the roadmap is launched and phase 1 begins. • **Synergies between stakeholders** will be greatly facilitated, for example by involving a stakeholder in medical equipment supply for every stakeholder supporting the electrification of the HF.	2024-2032	All levels
Implementation monitoring and evaluation to be considered	• **The effectiveness of the roadmap's implementation** will be assessed by a **monitoring and evaluation system** comprising tool development, DB updating (aided by telemetry), planned deliverables and communication, follow-up managers and regular monitoring and evaluation.	2024-2032	National

(1) Period depending on roadmap duration

CHAPTER 4.1

Technology

SUMMARY

A potential electrification market of 2,174 CSBs nationwide

The solar PV plant must include electrical equipment

Standardized technical solutions optimize electrification of CSBs

Energy audits of CHRDs are needed to define correct solution

Potential electrification market by 2030 estimated at 2,274 HFs including CSBs and CHRDs provided with stand-alone and back-up solar solutions

Various options have been selected for the electrification of HFs by IEP

JIRAMA grid

JIRAMA expansion

Private mini-grid

Solar plant

To ensure reliable, sustainable access to electricity, we need to consider 2 different solutions

BACK-UP SOLUTION
To ensure uninterrupted access to electricity

STAND-ALONE SOLUTION

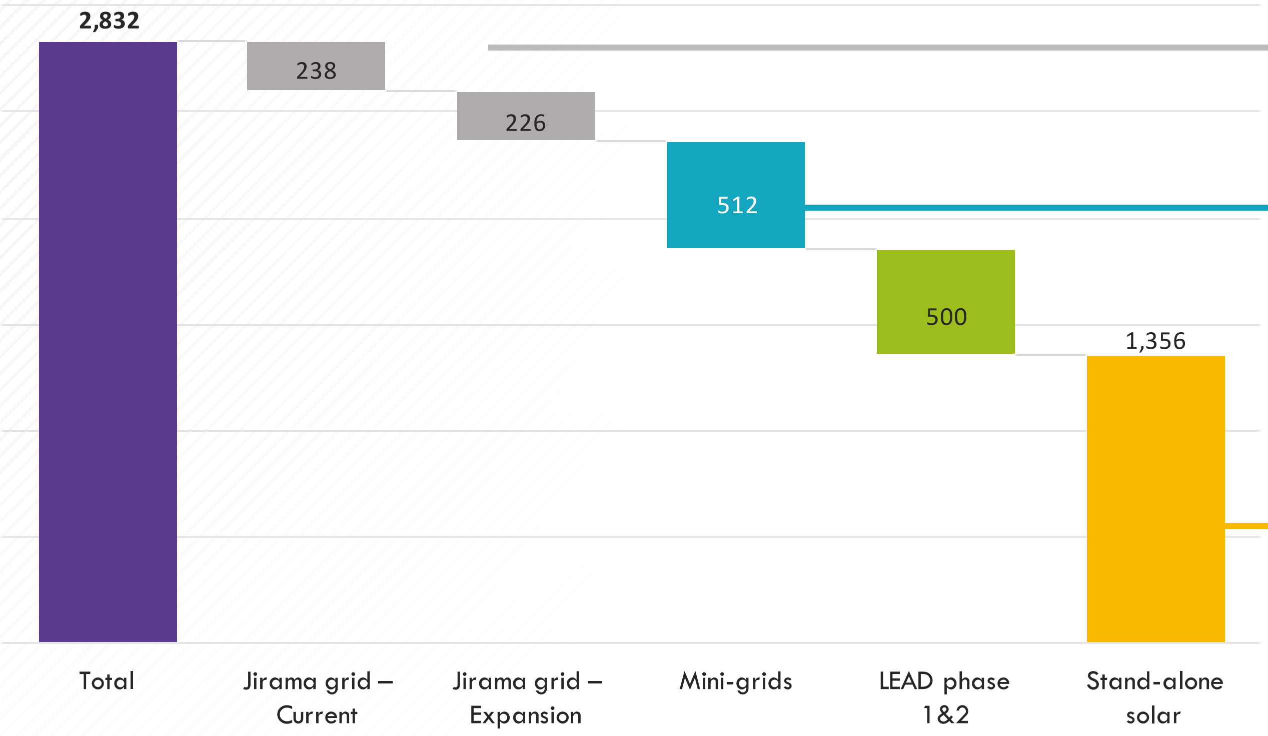
A number of hypotheses have been put forward to assess the needs of CSBs and CHRDs

Electrification must then be prioritized to ensure that "no one is left behind"

	Back-up solution	Stand-alone solution	
CSB	874	1,300	Different categories of solar solutions have been specified to cover the basic needs of CSBs according to 4 key criteria
CHRD	54	46	Given the wide variety of medical and non-medical equipment available in CHRDs, a tailored solution is required. An audit of all 106 CHRDs is therefore advisable.

CSBs – 2,174 HFs estimated as potential electrification market for CSBs by 2030

TOTAL CSB1 & CSB2



Calculation details for CSBs: Back-up solutions [(238+226)*100%]+(512*80%) = 874 HFs ; Stand-alone solutions = ~1,300 HFs; Total = 2,174 HFs

Source: projections from IEP report; (1) some operators will already have a profitable and sustainable business model. As a result, the CSB will not need a stand-alone solar plant

It is likely that CSBs connected to the JIRAMA grid (current and expanded) will require a back-up solution to guarantee a reliable power supply. **It is estimated that 100% of CSBs will use a solar back-up system.**

CSBs in areas electrified by mini-grids will have the opportunity to connect to the mini-grid and pay a monthly bill. However, it is likely that their resources/income will not be sufficient to pay for all their electricity needs. The final solution will depend on the business model envisaged. It is **estimated that 80% of CSBs will be supplied by a back-up solar plant,** with sufficient panels, enabling them eventually to sell the surplus back to the mini-grid operator.

CSBs located in **very remote areas** will require stand-alone solar PV plant for their electricity supply. Under the LEAD project, 500 basic health centres will be electrified. The remaining sites also need a reliable supply of electricity. Taking into account a number of local projects currently underway, it is **estimated that over 1,300 healthcare facilities will require stand-alone solar PV plants;** 1,000 of these will be electrified by the DECIM project by March 2028.

POTENTIAL MARKET:	Back-up solutions[1]:	Stand-alone solutions:
	874 HFs	**1,300 HFs**

Multi-dimensional solution - covering the basic needs of CSBs through solar plants comprising 3 key components, i.e, solar modules, batteries and inverter

AS OF TODAY

As indicated in Chapter 2, the general situation in CSBs is as follows:

- No access to electricity (75%)
- CSBs with access to electricity: suboptimal level
- Possibly a few lamps
- Independent solar refrigerator (76%)
- No sterilization

TARGET SITUATION

The aim is to cover the basic needs of CSBs. To achieve this, we need to consider:

ELEMENTS REQUIRING ELECTRICITY

	CSB 1	CSB 2
Sufficient lighting	✓	✓
Sterilization	✓	✓
Refrigeration	✓	✓
Digitalization	✓	✓
Housing	N/A	✓

A MULTI-DIMENSIONAL SOLUTION

Generation and storage	• Solar panels • Inverter	• Batteries
Medical and non-medical equipment	• Lighting • EE equipment[1] (LED lamps, tablet)[2]	• Indoor wiring to standards • Sterilizer
Management	• Telemetry solution	

Source: SEforALL/PHC field visits, project working group, DSSB and DHRD/MSanP (1) EE: energy efficient. (2) key digitization element.

4 main criteria for CSB solar PV plant sizing

1 HF TYPE

Request for services

TYPE	CSB1	CSB2
Basic needs	5.5 kWh/day	7.7 kWh/day

2 REGION

Different radiations[1]

IRRADIATION	LOW	AVERAGE	HIGH
Factor	0.8	0.9	1

3 ELECTRIFICATION

Electrification status

CONNECTED TO JIRAMA	CONNECTED TO A PRIVATE MINI-GRID	ISOLATED
Back-up if insufficient service	Back-up if insufficient service	Stand-alone solar

4 ATTENDANCE

Amount of services provided

LOW ATTENDANCE (BASE CASE) <200 visits per month	HIGH ATTENDANCE > 200 visits per month
Base case	30% more energy than base case

[1] Impact the capacity of PV solar panels to be installed.

2 areas to be defined for sizing CSB solutions: storage and solar PV generator

ASSUMPTIONS

Needs and battery storage

- 3 different battery storage sizes are designed to meet HFs in an efficient and modular way.
- Details of the electricity requirement assessment can be found in the appendices.
- Only energy-efficient equipment will be installed.
- Staff well-being is key to the sustainable improvement of healthcare services. For example, staff accommodation at CSB2s needs to be electrified.
- The batteries are dimensioned to cover 80% of the total daily demand; this is the equivalent of 20 hours of battery life.
- The single-phase inverter supplies the power required for the equipment envisaged.

Solar PV generator

- Three different sizes of solar PV plants are available to meet the needs of CSBs in an efficient and modular way.
- 400Wp modules are considered, 3 modules connected in series (standard solution on the market).
- Performance ratio: 60%.
- The solar PV, coupled with storage, provides a 24-hour power supply every month of the year.
- Additional requirements (e.g. water pumping/filtration) can be considered during the day, thanks to surplus production during daytime.

*See appendices

TYPE	ATTENDANCE	DEMAND* (kWH/DAY)	REQUIRE-MENTS (kWH/MONTH)	REQUIRE-MENTS (kWH/YEAR)	LABEL BATTERY + INVERTER SOLUTION
CSB1	Low	5.5	165	2,000	B4.5
	High	7.15	220	2,600	B6
CSB2	Low	7.7	235	2,800	B6
	High	10.0	305	3,600	B8

		LABEL SOLAR MODULE SOLUTION By radiation category (low/medium/high)		
TYPE	ATTENDANCE	LOW	AVERAGE	HIGH
CSB1	Low	PV3.6	PV2.4	PV2.4
	High	PV3.6	PV3.6	PV3.6
CSB2	Low	PV3.6	PV3.6	PV3.6
	High	PV4.8	PV4.8	PV4.8

N.B.: Only low-use CSB1s require different sizes of solar PV generator

Arriving at a suitable combination of solar module solution and battery + inverter solution for each CSB

Battery + inverter solution

LABEL	BATTERY usable kWh	INVERTER Wac
B2-Grid[1]	2.0	2,000
B4.5	4.5	2,000
B6	6.0	2,000
B8	8.0	2,000

\+

Solar module solution

LABEL	CAPACITY (kWc)	NO. OF MODULES (400Wc)
PV1.2	1.2	3
PV2.4	2.4	6
PV3.6	3.6	9
PV4.8	4.8	12

Solar power plant overview for every case

TYPE	ATTENDANCE	JIRAMA	PRIVATE MG	STAND-ALONE
CSB1	Low	B2-Grid-PV1.2	B2-Grid-PV2.4	B4.5-PV2.4 B4.5-PV3.6 [2]
	High	B2-Grid-PV1.2	B2-Grid-PV3.6	B6-PV3.6
CSB2	Low	B2-Grid-PV1.2	B2-Grid-PV3.6	B6-PV3.6
	High	B2-Grid-PV2.4	B2-Grid-PV4.8	B8-PV4.8

(1) The suffix "Grid" means that the inverter must be able to use the grid as a source of electricity, "B" indicates "Battery" solution (including the inverter) and "PV" indicates Photovoltaic solution; (2) If CSB1 is located in a region with low radiation.

Current CAPEX for each CSB solar plant estimated at USD 11,400 - 21,200 *a priori*

SOLAR PLANT	PV + REGULATORS (USD)	INVERTER (USD)	BATTERIES (USD)	WIRING (INTERNAL) (USD)	TECHNICAL BUILDING (USD)	EQUIPMENT EE (USD))	STERILIZER (USD)	DEVELOP-MENT (USD)	TRANSPORT & INSTALLATION (USD)	TOTAL CAPEX EXCL. VAT (USD)
B2-Grid-PV1.2	960	1,600	1,000	1,000	2,200	150	1,200	1,600	1,700	**11,400**
B2-Grid-PV2.4	1,920	1,600	1,000	1,000	2,200	150	1,200	1,800	2,000	**12,900**
B2-Grid-PV3.6	2,880	1,600	1,000	1,000	2,200	150	1,200	2,000	2,200	**14,200**
B2-Grid-PV4.8	3,840	1,600	1,000	1,000	2,200	150	1,200	2,200	2,400	**15,600**
B4.5-PV2.4	1,920	1,600	2,300	1,200	2,400	360	1,200	2,200	2,400	**15,600**
B4.5-PV3.6	2,880	1,600	2,300	1,200	2,400	360	1,200	2,400	2,700	**17,000**
B6-PV3.6	2,880	1,600	3,000	1,200	2,500	360	1,200	2,500	2,900	**18,100**
B8-PV4.8	3,840	1,600	4,000	1,200	2,600	360	1,200	3,000	3,400	**21,200**

OTHER CONSIDERATIONS

- The PV + battery part is tax-free
- The rest of the equipment is subject to VAT
- In Madagascar, an 8% import tax on public procurement is in place (2023)

COMPARATIVE NOTE - CONNECTING TO A MINI-GRID

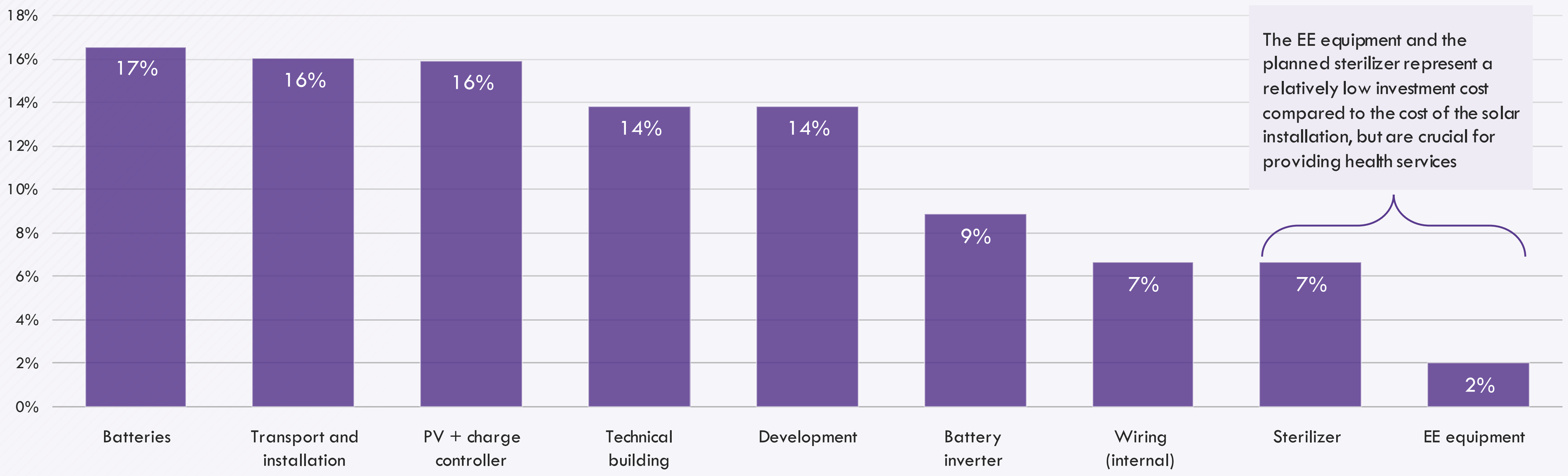
- Connection costs: approx. USD 1,000
- Annual electricity costs:
    - for a CSB1 (5.5-7kWh/day): USD 1,000-1,300
    - for a CSB2 (7-10kWh/day): USD 1,300-1,800

More details on CAPEX assumptions can be found in Appendix. (1) EE equipment includes tablet, bulbs and miscellaneous. (2) Transport and installation costs may vary by ± 20% depending on location.

Costs for sterilizer, lighting and tablet in CSBs represent less than 10% of total CAPEX costs

EXAMPLE

Cost breakdown for a B6-PV3.6 solar system



The EE equipment and the planned sterilizer represent a relatively low investment cost compared to the cost of the solar installation, but are crucial for providing health services

N.B.: EE equipment includes tablet, bulbs and miscellaneous; transport and installation costs may vary by ± 20% depending on location.

CSB OPEX and equipment replacement essential to sustainability of solar solutions

They must be assessed and taken into account at the design stage

OPEX

CATEGORY	BY WHOM	STRUCTURE RESPONSIBLE*	FREQUENCY	COST (USD)
Regular maintenance and module cleaning	Local staff	CSB	1x per month	By on-site staff
Preventive maintenance and repairs	Regional technician	MSanP	2 visits / year	200
Monitoring and control	Regional technician	MsanP	1x per month	150
Administrative management fees	Local staff	CSB	If required	100
Training and local expertise	Regional technician	MSanP	2x / year	Included in visits
Simple component replacement	Local staff	CSB	2x / year	50
			Total :	**USD 500 / year**

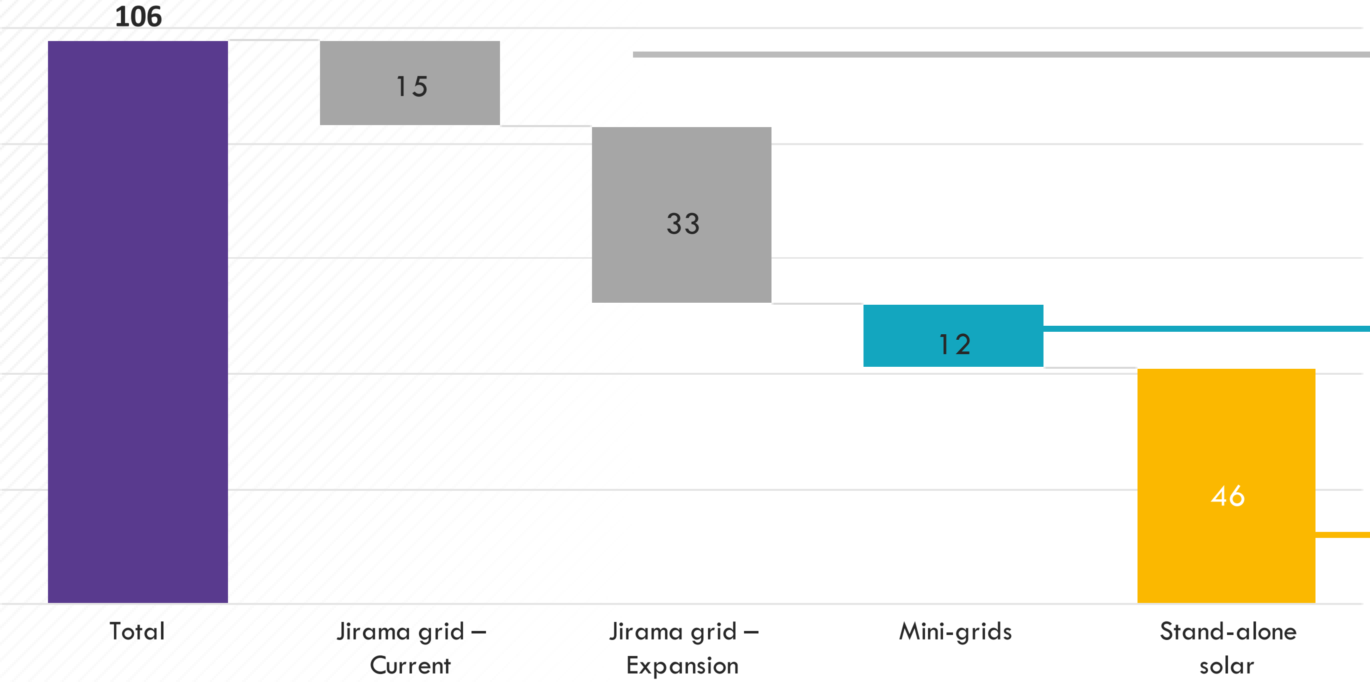
REPLACEMENT

STAND-ALONE SOLAR	BATTERY REPLACEMENT EVERY 5 YEARS (USD)	INVERTER REPLACEMENT EVERY 10 YEARS (USD)	ANNUAL EQUIVALENT (USD/YEAR)
B2-Grid-PV1.2	900 (180/year)	1,300 *(130/year)*	**310**
B4.5-PV2.4	2,100 (220/year)	1,300 *(130/year)*	**550**
B4.5-PV3.6	2,100 (220/year)	1,300 *(130/year)*	**550**
B6-PV3.6	2,700 (540/year)	1,300 *(130/year)*	**670**
B8-PV4.8	3,600 (720/year)	1,300 *(130/year)*	**850**

* Certain activities could be outsourced to a private operator where the CSB re-injects its electricity production into the mini-grid, and in exchange the operator takes on these O&M activities.

CHRDs – 100 CHRDs estimated to need solar PV solutions

CHRD



In order to guarantee uninterrupted supply of their priority services, CHRDs **connected to the JIRAMA grid will probably need a solar back-up system. It is estimated that 100% of HFs would need a solar back-up system.**

CHRDs connected to private mini-grids will probably have sufficient power if this has been taken into account when sizing the mini-grid. The appropriate solution here will depend mainly on the business model in place and the objectives of any installation (lower bills, 24-hour service). For these HFs, it is **estimated that in 50% of cases, a solar plant similar to that installed for CHRDs connected to JIRAMA will be installed in order to limit operating bills.**

CHRDs located in very remote areas will require stand-alone solar PV plants for their power supply. Power generators are extremely expensive to operate and will lead to restrictions and/or insufficient service. **It is estimated that 46 CHRDs will require stand-alone solar PV plants.**

The ideal solution may differ depending on the business model chosen. For example, if the chosen model envisages that OPEX or equipment replacement costs are covered by the energy re-injected into the grid, then a larger sizing would have to be considered.

POTENTIAL MARKET:	Back-up solutions:	Stand-alone solutions:
	54 HFs	**46 HFs**

Source: Projections from the PEI report **Calculation details for CHRDs:** Back-up solutions [(15+33)*100%]+(12*50%) = 54 HFs; Stand-alone solutions = 46 HFs; Total = 100 HFs

Pilot projects for electrification of CHRDs

- There are currently a number of pilot projects for CHRD electrification.
- The supply of electricity to healthcare facilities **has benefitted from *ad hoc* investment**, particularly in response to the **COVID-19 pandemic.**
- UNDP and PERER/GIZ specified that they do **not generally intervene in the health sector.**
- GIZ has noted that **some facilities have been partially redeveloped to meet other needs,** now that the impact of COVID-19 has subsided.

The electrification objectives differ between the 2 projects, which may result in a **significant variation** in the size and scope of installations. In addition, it would be beneficial to take a closer look at information concerning the operation and maintenance of these systems before planning large-scale electrification of CHRDs.

Betafo: solar PV plant and dentistry table

Source: SEforALL field visits, interviews with UNDP and GIZ

PROJECT SPONSOR	PNUD	GIZ
Name of CHRD	Betroka	Betafo Arivonimamo, Soavinandriana
Daily hospital consumption	Not specified	Not specified
Existing JIRAMA connection	Yes	Yes
Installed solar capacity per site	25.9 kWc	15.1 kWc
Storage capacity per site	57.0 kWh	27.5 kWh
Total system cost per site	USD 195,000	USD 60,000
Purpose of the solar power plant - services prioritized for sizing	Emergency, Surgery, Intensive Care, Medicine, Laboratory	Equipment used to treat COVID (oxygen extractors, COVID room lighting, related equipment, etc.)

Two case studies that can serve as pilot projects for the electrification of CHRDs in Madagascar

Case-by-case assessment to be considered due to varying range of energy-consuming equipment used

Depending on CHRD, **both medical and non-medical equipment vary** in type, number and energy requirements, given the diversity of health services on offer:

NON-EXHAUSTIVE LIST OF CHRD SERVICES

Admission-Triage-Emergency	Laboratory	Surgery[1]	Functional rehabilitation	Radiology
Medicine	Obstetrics and gynaecology	Dentistry	Intensive care	Pharmacy

The question for CHRDs is then: what is the **purpose of electrifying them?**

Ensuring a reliable power supply for priority services

Reducing current electricity expenses

It would therefore be useful to have a needs and energy audit for each CHRD1 and CHRD2 to assess the most suitable solutions (back-ups and stand-alone) according to: (i) the medical and non-medical equipment in operation; and (ii) the energy demand.

A tailor-made solution is therefore necessary

(1) For CHRD2 only.

3 key points to choose technology options

01

Solar plants must also include the necessary electrical equipment to reinforce the impact on health services

- Sterilizer integrated into the stand-alone solar PV plant **(represents USD 800-1000 or ≈5% of the total cost and very beneficial!)**
- Enabling digitization and optimization of operations with telemetry

02

Local ownership of the project and an integrated vision are key aspects of long-term sustainability of the solar PV plant

03

The quality of existing infrastructures must not be neglected in the planning and prioritization of solar plants

Photo credits: TTA/AIDES field visits, photo of an EE Poupinel sterilizer (giromedical.com)

CHAPTER 4.2

Business Models

SUMMARY

Without OPEX financing, no business model will be sustainable

Several conditions are key to adopting a sustainable business model

HF solvency can be improved through revenues and cost optimization

Various business models for HFE; revenue covering OPEX is key to sustainability

Build-Operate-Transfer (BOT)

- TFP finances CAPEX and 2-3 years of OPEX
- A private operator is hired to design, purchase and install, and is responsible for maintenance for 2-3 years
- After 2-3 years, HF takes over OPEX
- *The most widespread case in Madagascar today*

Energy-as-a-Service (EaaS)

- ADER[1] or TFP selects a private operator or NGO to provide electricity services for at least 10 years
- CAPEX to be raised by the service provider from TFPs or investors (impact)
- Provider handles activities from design to O&M
- *A model that is increasingly applied in Madagascar with the development of the private mini-grid market*

(1) Via AP for rural electrification

Pico PV Pay-As-You-Go (PAYG) system

- A private operator makes small-scale stand-alone solar power systems available to HFs via a PAYG system: rental or sale of a system in exchange for regular payments via mobile payment
- If no payment is received, the system can be disconnected remotely
- *Not currently available in Madagascar for HFs; but is available for private users*

Hybrid A model

- A private operator finances CAPEX for stand-alone solar or MG systems
- It charges an electricity supply and O&M fee/rate to an independent project management unit; HF is supplied with electricity
- *Not available in Madagascar*

Hybrid B model

- TFP in collaboration with MSanP/MEH launches RfP for stand-alone solar plants for min. 50 HFs (cluster)
- TFP finances 100% of CAPEX (including installation)
- Private operator invoices HF per kWh on a pre-paid basis at a preferential rate (approved) to cover O&M via a 5-7 year renewable contract
- *Not available in Madagascar*

In all cases, HFs must pay O&M and equipment replacement costs (stand-alone solar plant) or a monthly bill/ top-up (private mini-grid or JIRAMA).

→ The most important point is to find stable sources of revenue to cover OPEX costs over the long term; then, any business model is *a priori* possible.

Various business models for HFE; revenue covering OPEX is key to sustainability

1 2

The question of **OPEX coverage is a disadvantage shared by all business models,** as indicated two slides above (and not repeated as a disadvantage below)

BUSINESS MODELS	MAIN ADVANTAGES	MAIN DISADVANTAGES
Build-Operate-Transfer (BOT)	• Initial financing (CAPEX and OPEX for 2-3 years) provided by TFP • Optimization of CAPEX through economies of scale in purchasing • Quick installation of the solar PV plant • External expertise from design to installation by the private operator • 2-3 year O&M guarantee from the private operator, ensuring continuous operation and reducing the risk of breakdowns • The reduced risk of the initial financing may be advantageous to HFs, given the budgetary constraints of CSBs and CHRDs	• Short-term outlook (max. 3 years) • At the end of TFP financing, risk of contract non-renewal • It is difficult for HFs to ensure that equipment replacement will be covered • Limited local ability to manage and maintain solar plants • Limited ownership of solar plants because these are transferred from original owner (without any financial remuneration), thus risk of becoming nonfunctional if there are no funds available for repairs
Energy-as-a-Service (EaaS)	• Guaranteed supply of reliable electricity for at least 10 years • External expertise from design to operation by the private operator • HF has limited responsibility with regards to electricity supply and thus can focus on its core mission of providing healthcare services • Clear definition of ownership and responsibilities as regards the MG • Entry point for offering other energy services to the community • Opportunity to aggregate MG clusters, thus potential economies of scale	• There is currently limited electricity consumption for CSBs (lack of equipment), making providing electricity service to HFs unattractive for a private operator • Risk of CSB/municipality defaulting on electricity payments • Dependence on the private operator • If CSB is already electrified via stand-alone solar plant, interest in connecting to the grid may be limited
Pico PV system Pay-As-You-Go (PAYG)	• Fast, affordable electrification • Simplified O&M management for the private operator of the stand-alone solar PV plant (pico PV) • Flexibility of payment according to HF creditworthiness at time "t" • HF payment motivation in order to avoid remote disconnection	• Dependence on the private operator • Risk of disconnection upon non-payment, with serious impact on provision of care • Cumulative costs are often higher than direct purchase • Limited capacity (pico), especially for CHRDs, to power all medical and non-medical equipment • Difficult to make mobile payments, particularly in remote areas, by the municipality responsible for electricity payment costs

Various business models for HFE; revenue covering OPEX is key to sustainability

1 2

The question of **OPEX coverage is a disadvantage shared by all business models,** as indicated two slides above (and not repeated as a disadvantage below)

BUSINESS MODELS	MAIN ADVANTAGES	MAIN DISADVANTAGES
Hybrid A model	• Initial financing (CAPEX) provided by the private operator • Quick installation of the stand-alone solar or MG system • Private operator technical expertise from design to installation • Private operator not dependent on the municipality/district or a public institution • Fund management and reimbursements by a dedicated management unit • Management unit can be independent • Aggregate solutions (critical mass) for economies of scale and broader implementation • Opportunity to offer combined services (such as productive uses of energy)	• Private operator responsible for fundraising • Stakeholder commitment needed on a regular and sustained basis to ensure trust of private operators and investors • Effective creation of the management unit • Scheduled repayments are less capital-intensive in system PV plants than in MGs • Dependence on the private operator • Cumulative costs often higher than direct purchase
Hybrid B model	• Initial financing (CAPEX) provided by TFP • Quick installation of the solar PV plant • Affordable solution for the HF thanks to a preferential kWh rate agreed in advance • Aggregate solutions (critical mass) for economies of scale and broader implementation • O&M handled by private operator	• Dependence on the private operator • Risk of non-renewal of the contract with the private operator at the end of TFP financing • Managing contracts with several HFs can become complex for the private operator • Ongoing verification of private operator rates and performance is needed

Key factors for sustainability and success of business models

Better HF ability to pay over the long term

- Securing different sources of financing
- Optimizing electricity costs

Greater involvement of the private sector

- Enabling the private sector to play its role as a long-term provider of energy services (including O&M)

Appropriate sizing of the stand-alone solar plant

- Evaluating future medical and non-medical equipment
- Considering oversizing to generate additional revenue to cover operating costs (re-injection of surplus electricity into a grid, telephone recharging, etc.)

A more integrated and coordinated approach among key stakeholders

- Including all aspects to improve health services for the population, not just electrification
- Defining the roles and responsibilities of each stakeholder to achieve greater impact
- Coordinating all interventions

HF meets the *sine qua non* conditions for sustainable electrification

- Showing and proving that the HF is interested and wishes to obtain sustainable electrification (bottom-up)
- Meeting prioritization criteria in national planning (top-down)

Targeted capacity-building

- Providing technical training in electricity for local and multi-site staff
- Raising awareness about responsible use and maintenance of electricity, including through visuals/posters at HF

HF solvency can be improved by cost optimization and revenue generation

As stated in Chapter 3, Current and Future Challenges, the profitability and sustainability of business models are largely compromised by **HFs' low ability to pay. Cost optimization and revenue generation** are therefore crucial.

	TYPES OF ACTIVITY	STAKEHOLDERS/BENEFICIARIES	LEVEL	PERIOD	STAND-ALONE SOLAR PV PLANT	PRIVATE MINI-GRID/JIRAMA
FINANCING: COST OPTIMIZATION	**Practical training for local staff in basic maintenance,** including regular servicing, module cleaning and diagnostics of potential electrical equipment problems, reducing travel costs for a private operator[1]	Local non-medical staff from the HF and/or the municipality - minimum 2-3 people (due to rotation) for stand-alone solar plants Electricians for private mini-grids	Local	2024-2030	✔	✔
	Practical training in technical repairs[1]	Regional technician/MSanP	Regional	2024-2030	✔	✘
	Training of trainers in all key electrical and plant maintenance areas to ensure knowledge transfer[1]	Regional and national technician/MSanP	Regional/ National	2024-2030	✔	✘
	Trained technician covering several HFs[1]	MSanP or district	Local/Regional/ National	2024-2030	✔	✘
	EE equipment (e.g. LED bulbs, EE ultrasound scanner, etc.)	HFs	Local/ National	2024-2030	✔	✔
	Data costs (telecom) for telemetry for preventive maintenance and monitoring (failure or incident alerts, electricity consumption monitoring and possible deduction if HF misuses electricity) and data analysis	Private operator	Local/ National	2024-2030	✔	✔

[1] Subsidy/contribution in kind from TFP or NGO so no need for expenditure

Source: TTA analysis, bilateral interviews, stakeholder consultation workshop in October 2023 (1) Period based on roadmap duration.

The cornerstone of the business model is HF solvency, which would be enhanced through cost optimization and revenue generation

1 2

	TYPES OF ACTIVITY	STAKEHOLDERS/BENEFICIARIES	LEVEL	PERIOD	STAND-ALONE SOLAR PV PLANT	PRIVATE MINI-GRID/JIRAMA
FINANCING: SOURCE OF INCOME	**Sale of services** to be considered • Phone recharging • Printing/photocopying • Fresh clean water (if small water treatment system available) • Other	HF administrative staff	Local	2024-2030	✓ To cover a portion of O&M costs	✓ To cover the cost of replacing LED bulbs etc.
	Re-injection into the grid for sites connected to JIRAMA or mini-grids	JIRAMA / Private mini-grid operator	Local	2024-2030	✓ With the arrival of a grid, a HF with stand-alone solar PV plant could reach an agreement with the operator to take on all or part of the O&M of the HF's solar plant, in exchange for re-injection of surplus electricity generated by the HF (especially during daytime).	
	Re-injection into the grid for sites connected to JIRAMA or mini-grids	Private operators	National/ International	2024-2030	✓ Review how to include OPEX coverage over a longer period than 3 years, such as by setting up a revolving fund.	✗
	Reach out to regional representatives to benefit from their power to lobby for budgetary extension at central level	HFs	Local/ Regional	2024-2030	✓ More budget for O&M and equipment replacement costs	✓ Could support expansion of private MG for HF

Source: TTA analysis, bilateral interviews, stakeholder consultation workshop in October 2023 (1) Period based on roadmap duration.

The cornerstone of the business model is HF solvency, which would be enhanced through cost optimization and revenue generation

1 2

FINANCING: SOURCE OF INCOME

TYPES OF ACTIVITY	ACTEURS/ BÉNÉFICIAIRES	LEVEL	PERIOD	STAND-ALONE SOLAR PV PLANT	PRIVATE MINI-GRID/JIRAMA
Municipality allocations for HF O&M costs	Municipality/ CoGES	Local/ National	2024-2030	✔ Could cover part of the O&M costs, as there is no JIRAMA electricity bill, as is the case for other HFs	✔ In the case of a private MG, the monthly bill should be covered by this allocation, as with JIRAMA
Additional municipal tax to be considered (other than private MG operator's municipal tax for street lighting and grid extension)	Municipality/ Mayor	Local/ National	2025-2030	✔ In the case of a private MG, the monthly bill should be covered by this allocation, as with JIRAMA	✔ In the case of a private MG, could cover the HF monthly electricity bill
MID **Local Development Fund** (LDF)	HFs	Local/ National	2025-2030	✔ Could cover part of CAPEX including equipment replacement or capacity expansion as HF needs change	✔ Could cover part of the MG's investment cost in exchange for a reduction/exemption of monthly bills for the HF (and other social infrastructures) for a given period of time
Climate finance funds to reduce GHGs, increase resilience to climate impacts and promote sustainable development	HFs/ Private operators	Interna-tional	2026-2030	✔ Could cover CAPEX and OPEX costs (O&M, equipment replacement, training, etc.)	✔ Could cover CAPEX and OPEX costs (O&M, grid extension, EE, community links, etc.)
Decentralized renewable energy certificates (DRE-C) bought and sold to demonstrate commitment to using and promoting clean energy	MSanP/ Private operators	Interna-tional	2026-2030	✔ Could support OPEX costs for HF using RE as an energy source	

Source: TTA analysis, bilateral interviews, stakeholder consultation workshop in October 2023 (1) Period based on roadmap duration.

Levers for sustainability of HFE already tested in Madagascar

1 2

INCOME THROUGH NON-MEDICAL SERVICES IN 5 ELECTRIFIED CSBs IN THE SOUTH

- **Agreement to generate additional income for the maintenance of stand-alone solar plants by:**
  - The MSanP Regional Department of Public Health (DRSP)
  - Fokontany (district) chiefs
  - District medical inspectors
- Additional income generated via:
  - **Phone recharging** between MGA 300-500 (USD 0.07-0.11)
  - **Photocoping** (black and white and color) between MGA 200-1000 (USD 0.04-0.22)

> *We have no current estimate of the amount of monthly income generated by these activities, but our experience is that health centres have been able to finance initial small repairs and spare parts through these income-generating activities.*

Doctors for Madagascar

ANKA MADAGASCAR

Source: Doctors for Madagascar, SEforALL/PHC field visits

Levers for sustainability of HFE already tested in Madagascar

1 2

MAINTENANCE TRAINING FOR LOCAL HF STAFF

- **Training in regular maintenance and cleaning of PV modules as part of the electrification of CSB and CHRD respectively in World Bank's LEAD project and GIZ's PERER project, for:**
  - HF Chief Medical Officers
  - HF security guards
- These training courses were provided by the private service providers who installed the stand-alone systems, e.g. Madagreen.
- The electrical installation diagram, a user's manual and other visual aids were also shared with the HF to raise awareness of the operation and maintenance of stand-alone solar PV plants.

THE WORLD BANK giz

Source: SEforALL/PHC field visits

CHAPTER 4.3

Integration

SUMMARY

A shared goal: improving care

Multi-stakeholder coordination to be institutionalized

Multi-dimensional indicators to be defined and monitored

Integrating electrification with other aspects is key to improving health services

Adopting an integrated approach to ensure project success

Source: TTA analysis and benchmark of other projects carried out by TTA, project working group

Long-term integration facilitated by synergies between key players and institutionalized coordination

INTER-MINISTERIAL COORDINATION

Successful sustainable electrification of HFs requires a platform for coordination between various key ministries. Other ministries and agencies may be added.

FACILITATING SYNERGIES BETWEEN KEY PLAYERS

This study, including IEP- Health GIS mapping, will enable stakeholders to be informed about each other's activities, to meet up, exchange ideas and see how they can work together (if applicable).

LONG-TERM WORKING GROUP

The project has initiated a multi-stakeholder, multi-sector working group on the health-energy nexus. Giving it institutional status would enable this dynamic to continue and contribute to the successful implementation of the roadmap.

Ministère de la Santé Publique | MEH | Agence de Développement de l'Electrification Rurale | MEF Ministère de l'Economie et des Finances

Government/ public sector

TPF/NGO

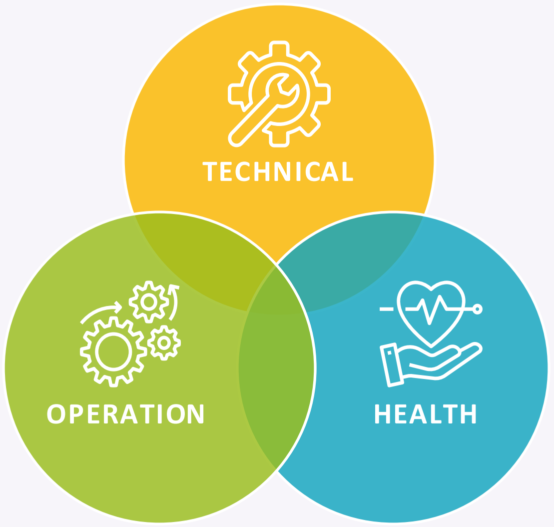
Private sector

Others
Research, etc.

Technical, operational and health indicators for successfully integrated electrification projects

INDICATOR OR DATA	RESPONSIBLE
Energy produced by the HF	Regional technician
Energy consumed by the HF	Regional technician
Technical losses	Regional technician
Number and frequency of interruptions	Regional technician
System power	Regional technician
Solar PV plant power	Regional technician
kW fed into the grid (if applicable)	Regional technician
Alarms	Regional technician
Operating hours	Regional technician
Births per month	Health centre
Surgical procedures per month	Health centre
Visits per month	Health centre
Improved electricity-related services	Health centre
Access to water	Health centre

A number of these indicators could be monitored by telemetry



These **multi-dimensional indicators** will permit an **integrated assessment of the success of HFE projects** in Madagascar, taking into account both the technical aspects and the social benefits for the local population.

Source: TTA analysis and benchmark of other TTA projects

CHAPTER 4.4

Roadmap for HF electrification

SUMMARY

A roadmap based on a bottom-up and integrated approach

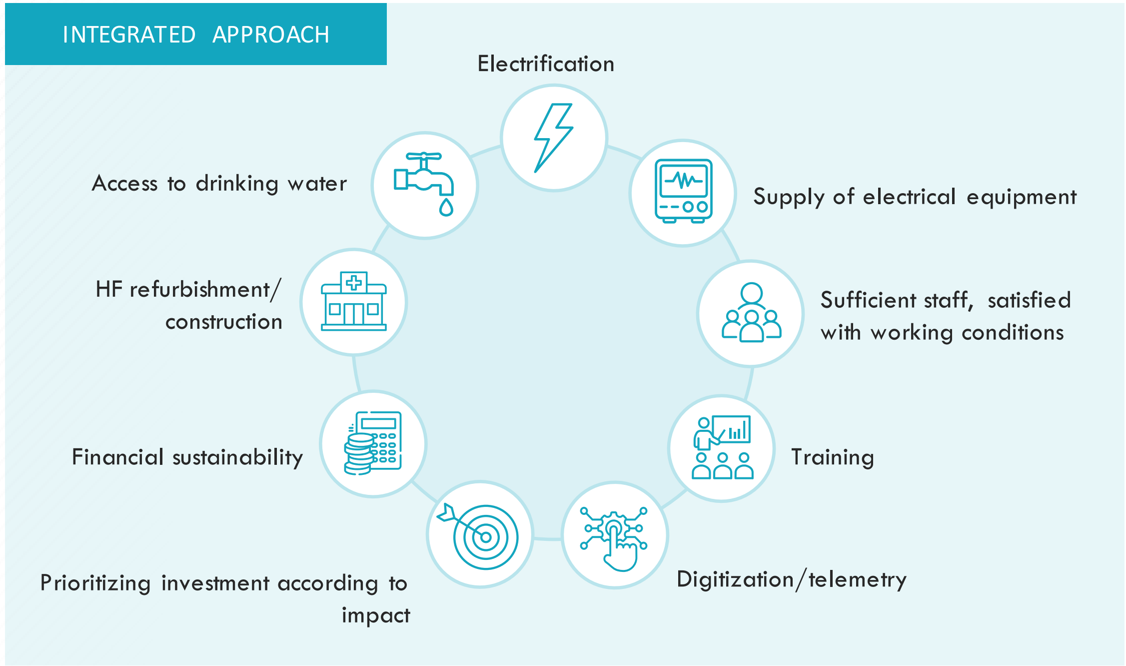
A step-by-step approach

A financing and fundraising plan to be developed

Key players with specific, synergistic roles

Consider a monitoring and evaluation strategy

Roadmap based on an integrated programme with a bottom-up, integrated approach



The key is the impact that energy can have on health, not access to electricity *per se*. The roadmap is therefore not limited to the sustainable electrification of CSBs and CHRDs, but constitutes an **integrated programme for the improvement of healthcare services in Madagascar:**

- It adopts a **mainly bottom-up approach**, starting with HFs and their desire to improve the healthcare services they provide, notably through sustainable electrification.
- It integrates all the key elements contributing to **the improvement of healthcare services**, as well as all the players involved.

Bottom-up approach at the core of the roadmap

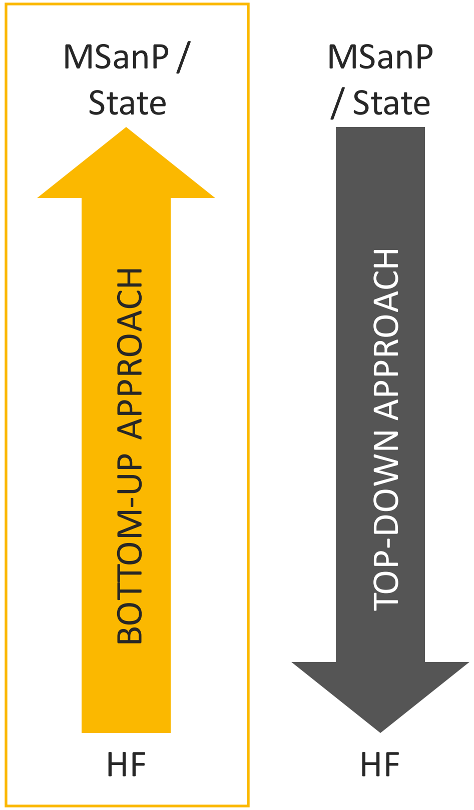
THIS APPROACH ENSURES THAT THE REAL NEEDS AND DESIRES OF HF ARE CONSIDERED, AND IS THEREFORE SUSTAINABLE

Sustainable electrification of HF will only be successful if **HF are convinced that electricity is a real need and essential for improving health services** on a daily basis and in the long term.

The bottom-up approach is the key element of the roadmap.

To this end:

- An **application system** based on a **call for proposals** and **spontaneous applications** will be set up.
- Applications will be **evaluated using a point system** for each criterion (location/remote area, expected impact of access to electricity, etc.) based on the prioritization criteria defined by MSanP (bottom-up approach). Applications will be assessed by **an integrated programme evaluation committee.**



The top-down approach complements the bottom-up approach:

- **Planning the electrification of HF across the entire country,** including **prioritization criteria,** is necessary to ensure balanced geographical coverage. The IEP 2030 horizon is an essential tool here.
- **Centralized monitoring** of HFE project implement-tation, electrification status and other key indicators, as well as their impact on improving health services, will be implemented. This monitoring will feed into the **IEP** to ensure that **DB and GIS maps are updated.**
- **A selection of intervention areas/regions.**
- **Coordination between key stakeholders.**

6 key elements of the integrated programme

THESE ARE IN ADDITION TO THE *SINE QUA NON* BOTTOM-UP APPROACH

1. FACILITATOR ROLE

The integrated programme acts as a facilitator and coordinator between stakeholders and interventions

2. FINANCING SUPPORT

Supporting O&M and equipment replacement through local sustainability funds (not financed by TFPs and including local revenues) and a central support fund (financed by TFPs and others)

3. POOL EFFORTS

Achieve economies of scale in purchasing (equipment and services), including through a batch approach

4. UNIFORM CRITERIA

Contributing to the uniform use of criteria, categories and standards through the programme's different stakeholders and interventions

5. LOCAL OWNERSHIP

Involving and empowering HFs in improving health services, including electrification (bottom-up approach)

6. INCLUSION OF DIFFERENT AREAS

All areas impacting on the improvement of healthcare services are taken into account

3 phases of the roadmap

The roadmap will be broken down into phases to improve health services, including universal and sustainable access to electricity for HFs by 2032

PHASE 1

STRUCTURING & CLUSTER TESTING

2024-2025

PHASE 2

DEMONSTRATION & IMPLEMENTATION

2025-2028

PHASE 3

CONSOLIDATION

2029-2032

Phase 1 - Structuring the integrated programme with the key stakeholders and setting up a pilot project on the sustainable solvency of HFs

PHASE 1: Structuring & Cluster Testing / 2024-2025	
Main activities	• Institutionalizing the health-energy nexus working group, including all the key themes of the integrated programme (in committees or otherwise). • Sharing of information and promotion of synergies between TFP interventions for the electrification of HFs and other aspects, including the supply of medical equipment. • Formulation of the integrated programme, including TFP interventions, key stakeholders to be included (institutionalized working group) and bottom-up/top-down approach. • Designing a fundraising strategy for the programme. • Establishment of a multi-donor revolving fund to assist with HF OPEX (in the event of default at local/HF level) in the integrated programme. • Carrying out an audit of all 106 CHRDs to assess their needs and determine the most appropriate solar design for each CHRD. • Setting (minimum) standards for solar PV systems, equipment and tender documents. • Design and implementation of a cluster of 15-20 HFs to test business models (including OPEX financing) and bottom-up, integrated approach (e.g. via WB LEAD/DECIM). • Definition of a process (including managers/responsibilities) to ensure regular updating of HF electrification data in IEP DB/mapping (including health indicators). • Development of the monitoring and evaluation system of the integrated programme, including telemetry in each HF (including those responsible, periodicity and deliverables).
Main results	• Integrated programme formulated and budgeted, including synergies, ministerial coordination, institutionalized working group and creation of project management unit. • Circulation of initial elements of feasibility demonstration to ensure HF solvency. • HF electrification planning fine-tuned, including budget and key players. • The database is updated regularly, via telemetry, including planning.

Phase 2 - ~1,700 HF with stand-alone solar plants and more sustainable business models

PHASE 2: Demonstration and Implementation / 2025-2028	
Main activities	• Inclusion of lessons learned from cluster testing. • Development and launch of calls for projects for HFs so that they can benefit from integrated programme support (bottom-up approach). • Design and deployment of the programme's communication plan, including raising awareness of the call for proposals and the importance of sustainably improving healthcare services across the country. • Deployment of appropriate business models following the pilot for HFs already electrified and those to be electrified during this phase, in synergy with other integrated programme aspects. • Regular updating of the DB/map and IEP - HF part. • Ongoing monitoring of integrated programme implementation and specification of corrective measures where necessary. • Mid-term assessment of the integrated programme.
Main results	• At least 1,500 CSBs and CHRDs have applied to benefit from the integrated programme, including electrification or expansion. • ≈600+ HFs already electrified by previous interventions see their business model made more sustainable. • More than 1,000 CSBs are electrified (including 1,000 via DECIM) with levers to further ensure their sustainability. • At least 120 CSBs with access to electricity other than stand-alone solar have a backup solution installed (with stand-alone solar). • The database is regularly updated, specifically via telemetry. • Communication relating to the integrated programme is up and running. • The conclusions of the mid-term assessment are taken into account for phase 3.

Photo credit: TTA/Aides. LEAD project CSB2 Ambohimasina, August 2023

Phase 3 - All CSB/ CHRDs with sustainable access to reliable electricity and improved health services

Photo credit: TTA/Aides. LEAD project CSB2 Ankilizato, August 2023

PHASE 3: **Consolidation / 2029-2032**	
Main activities	• Additional communication and capacity-building efforts with HFs that have not yet benefitted from the programme, including visits to beneficiary sites. • Additional fundraising to ensure programme success and sustainability. • Continued regular monitoring of integrated programme implementation and implementation of corrective measures where necessary. • Formulation and implementation of a sustainability strategy for improving healthcare services, including electrification of CSBs and CHRDs. The OPEX revolving support fund is an integral part of this, as is the multi-stakeholder, multi-dimensional committee. • End-of-programme assessment. • Discussions on extending the integrated programme to other HFs and other social infrastructures, particularly in rural areas.
Main results	• 100% of CSBs and CHRDs have a stand-alone solar plant and a sustainable business model, or have benefitted from an expansion of the installation and, accordingly, improvement of the health services offered. • Health indicators have improved significantly in CSBs and CHRDs. • The database is regularly updated, including via telemetry. • Communication relating to the integrated programme is up and running. • The sustainability strategy includes the conclusions of the end-of-programme assessment and envisages an extension of the scope to other HFs and other social infrastructures.

USD 83 million investment required over 10 years to electrify all CSBs and CHRDs

This includes USD 52 million in CAPEX and USD 31 million in OPEX

CSB1 & CSB2

SOLAR PV PLANT	CAPEX (USD)	OPEX[1] (USD/AN)	NUMBER OF CSBs	TOTAL CAPEX (MUSD)	TOTAL OPEX (MUSD/YEAR)
B2-Grid-PV1.2	11,400	810	278	3.2	0.2
B2-Grid-PV2.4	12,900	810	297	3.8	0.2
B2-Grid-PV3.6	14,200	810	148	2.1	0.1
B2-Grid-PV4.8	15,600	810	151	2.4	0.1
B4.5-PV2.4	15,600	1,050	245	3.8	0.3
B4.5-PV3.6	17,000	1,050	105	1.8	0.1
B6-PV3.6	18,100	1,170	470	8.5	0.5
B8-PV4.8	21,200	1,350	480	10.2	0.6

A joint fundraising strategy will be developed and implemented as part of the roadmap.

CAPEX	OPEX (10 years)
USD 36 M	USD 23 M

CHRD

Reminder: an energy audit will be required on a case-by-case basis for CHRDs. Average values have been estimated here.

SOLAR PV PLANT	CAPEX (USD)	OPEX[1] (USD/YEAR)	NUMBER OF CHRDs	TOTAL CAPEX (MUSD)	TOTAL OPEX (MUSD/YEAR)
Back-up	120,000	6,500	54	6.5	3.5
Stand-alone	200,000	10,200	46	9.2	4.7

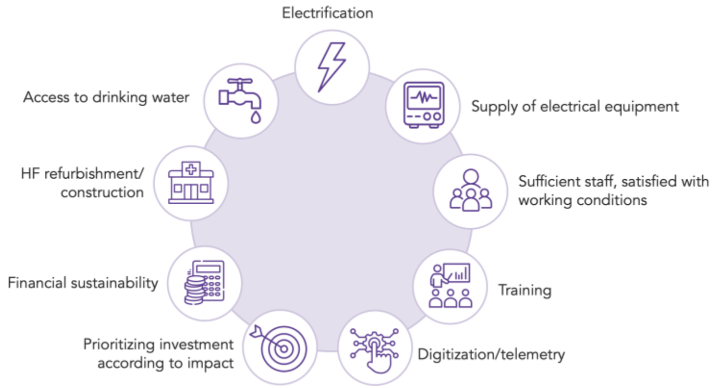
CAPEX	OPEX (10 years)
USD 16 M	USD 8 M

(1) Includes provision for equipment replacement (batteries, inverters).

Stakeholder collaboration required for successful implementation of the roadmap

STAKEHOLDER MAPPING

ACTEUR	RÔLE DANS LA FEUILLE DE ROUTE/LE PROGRAMME	PROJETS/ INTERVENTION	INTERVENTION LEVEL
GOUVERNEMENT MALAGASY & SECTEUR PUBLIC			
MSanP/DSSB			
MSanP/DHRD			
MSanP/DEPSI			
MEH			
…			
PTF			
ONG			
SECTEUR PRIVÉ			



RESPONSIBILITY MATRIX SUMMARY

	ROLE 01	ROLE 02	ROLE 03	ROLE 04	ROLE 05
TACHE 01					
TACHE 02					
TACHE 03					
TACHE 04					
TACHE 05					

TOPICS TO BE DEFINED BY THE WORKING GROUP

- A stakeholder mapping exercise is needed to map all players involved in all the aspects that impact the improvement of healthcare services.
- The role of each player will thus be identified. Synergies will be highlighted in order to pool and capitalize on impacts.
- The meeting of the health-energy nexus working group will provide an opportunity to draw up a first draft.

Monitoring and evaluation system to assess effectiveness of roadmap implementation

TOPICS TO BE DEFINED BY THE WORKING GROUP

MONITORING AND EVALUATION SYSTEM

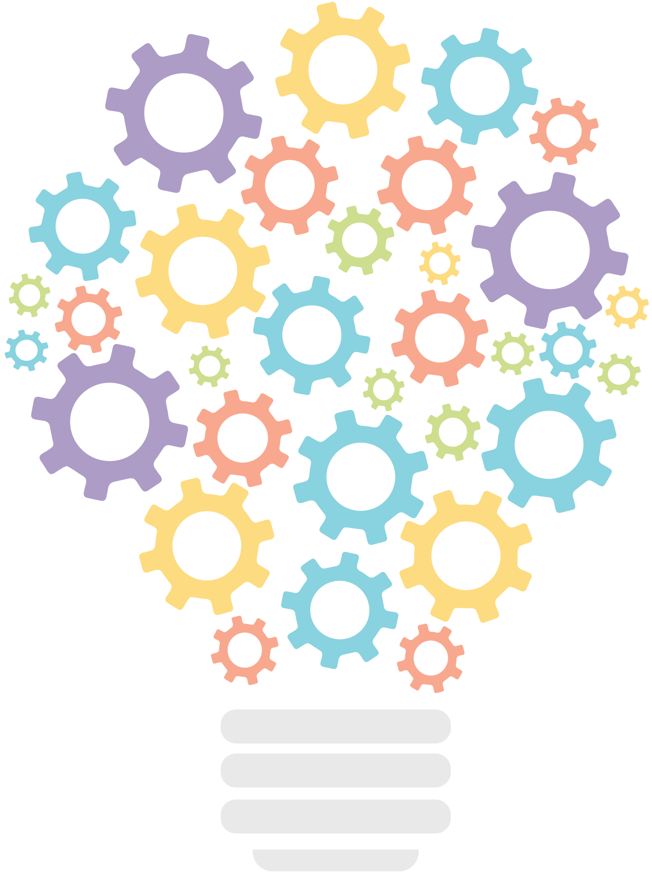
Establishing the tool for monitoring and evaluating the roadmap; validating it with the steering committee.

DATABASE

Updating the IEP - Health database regularly (using telemetry), defining a single label for HF, etc.

DELIVERABLES

Defining the diverse deliverables to be produced and the associated communication strategy.



MANAGEMENT

Identifying the entity (entities) responsible for monitoring and evaluation, including regular updating of the IEP - Health database.

FREQUENCY

Defining the frequency of monitoring and independent assessments.

CHAPTER FIVE

Conclusions

Photo credit: Rija Solo/ Pulitzer Center

The assessment of the market in Madagascar has helped us identify the main challenges and suggest specific recommendations for sustainable HFE

THE SITUATION

- The majority of the 2,832 CSBs and 106 CHRDs are under-equipped[1] in relation to MSanP standards.
- 75% of CSBs have no access to electricity, however, 90% of CSBs are equipped with at least a solar refrigerator.
- CHRDs normally all have access to electricity (including ≈50% from JIRAMA) but it is limited.
- There are a multitude of DBs, but no consolidated, centralized DB, making it difficult to access reliable, up-to-date data.
- Efforts have been made in terms of a policy and regulatory framework, but without an integrated/multi-sectoral approach.
- Although there are numerous stakeholders and interventions, the approach is siloed.

CHALLENGES

- Planning the electrification of HFs is difficult.
- The technical challenges are multiple: lack of standards for HFE; insufficient dedicated staff trained in electrical aspects; buildings often unsuitable for rooftop solar plants; often inadequate medical equipment, etc.
- Sustainability not given particular consideration, notably due to the low solvency of HFs and their ability to cover O&M costs, equipment replacement (stand-alone solutions) and even electricity bills (private MG and JIRAMA).
- Vulnerable groups and their needs are not sufficiently taken into account.
- A siloed approach by the different stakeholders that limits the improvement of healthcare services.

RECOMMENDATIONS

- A potential electrification market of 2,174 CSBs and 100 CHRDs (2,274 HF in total) by 2023, with a mix of back-up and stand-alone solutions.
- Suitable solutions for each CSB through categorization.
- An energy audit of 106 CHRD is necessary to define the right solution, tailored to their diversity.
- Improving the solvency of HFs (especially CSBs) is essential to cover OPEX costs, otherwise business models will not be sustainable.
- Sustainable electrification of HFs is not enough: it must be a key lever in an integrated approach to improving health services in a sustainable way.
- The roadmap is based on a bottom-up approach in which the HFs are at the core of an integrated programme to improve health services in general and access to electricity in particular. The electrification of CSBs and CHRDs amounts to USD 83M over 10 years.

(1) Medical and non-medical equipment

The step-by-step roadmap will enable universal and sustainable electrification of HFs to be achieved as part of the improvement of health services (integrated programme), and will need to be adapted as progress is made

PHASE 1

STRUCTURING & CLUSTER TEST

2024-2025

PHASE 2

DEMONSTRATION & IMPLEMENTATION

2025-2028

PHASE 3

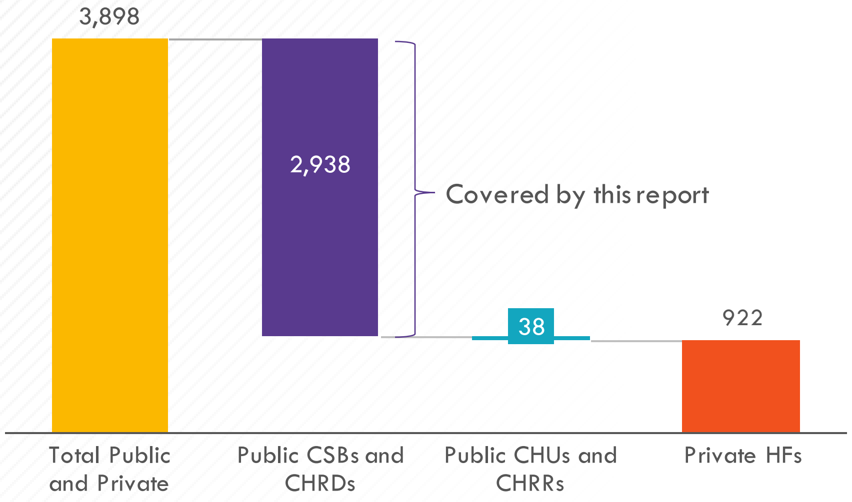
CONSOLIDATION

2029-2032

A similar study covering all public and private HFs and other social infrastructure could be considered

HEALTHCARE INSTITUTIONS

Number of sites

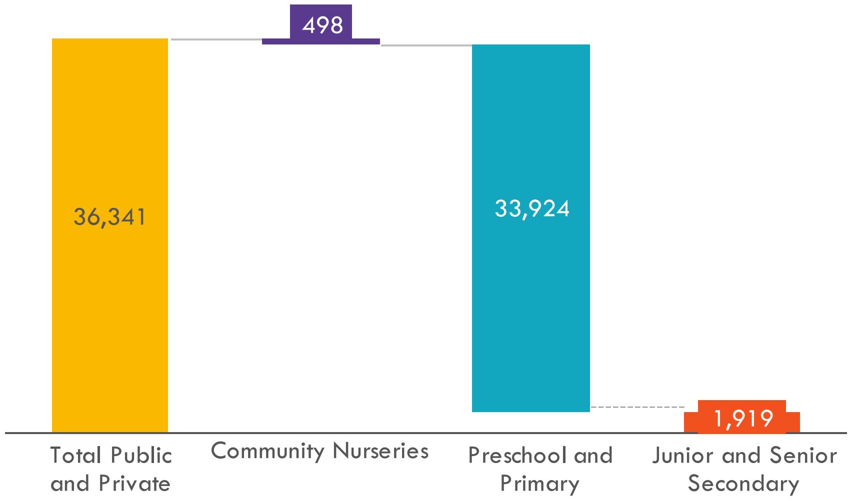


NEEDS

- Lighting
- Medical and non-medical equipment
- IT / Digitization

SCHOOLS

Number of sites



NEEDS

- Lighting
- IT / Digitization

OTHERS

- Universities
- Vocational training centres
- Vocational training centres
- Transport / Stations
- Etc.

NEEDS

- Lighting
- Equipment
- IT / Digitization

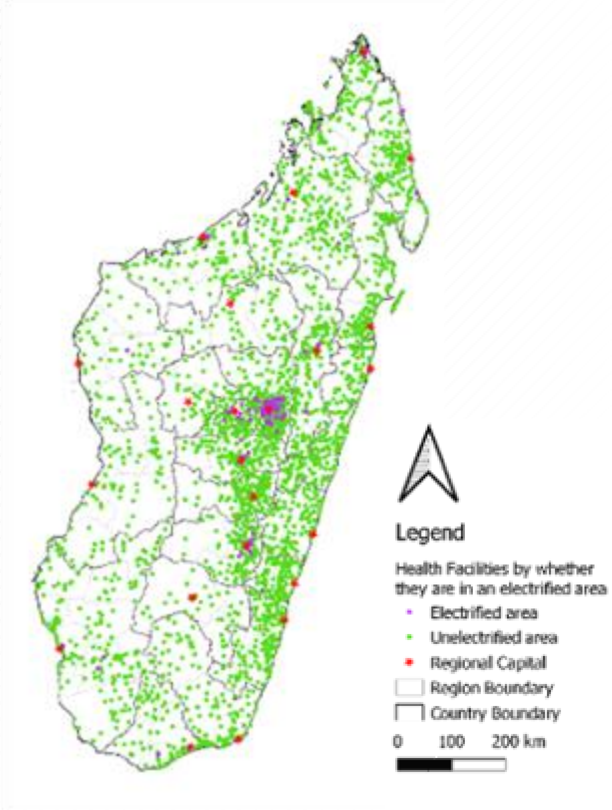
Photo credit: UNICEF

CHAPTER SIX

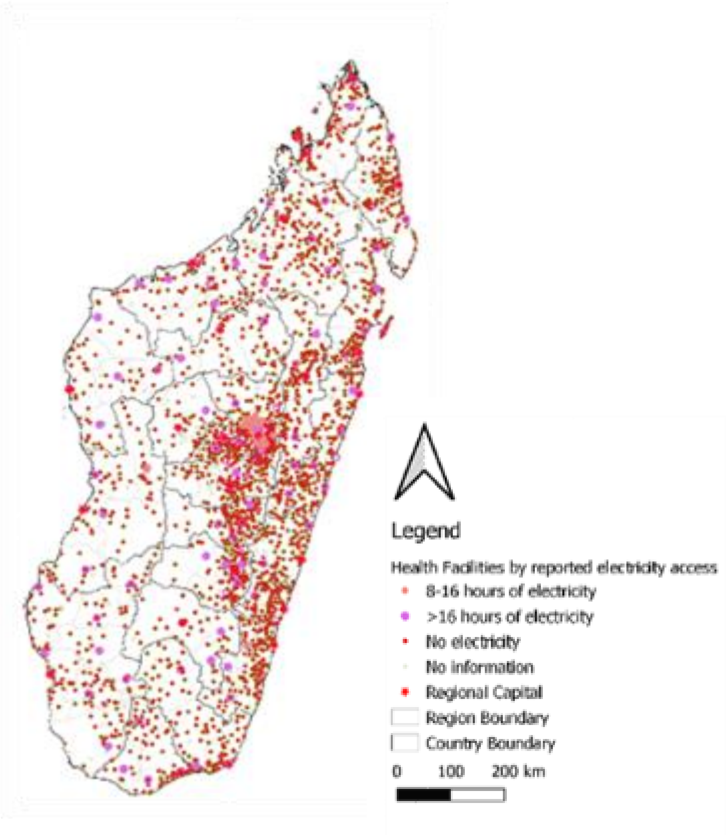
Appendices

A. Preliminary mapping results (that will be updated by IEP in the coming months) can be useful to provide an overview of HFE

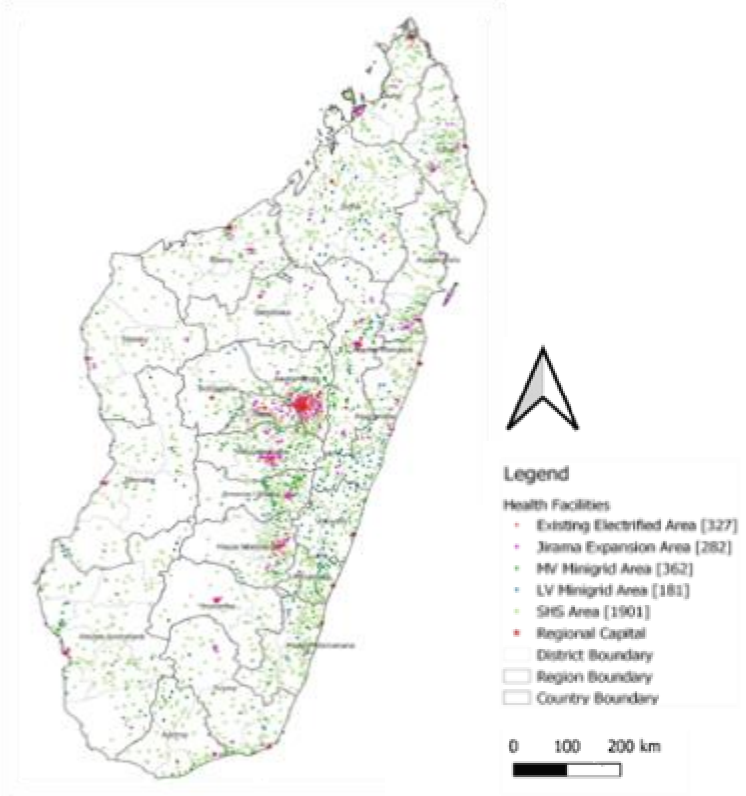
HF IF IN ELECTRIFIED ZONE



ELECTRIFICATION STATUS INDICATED



LEAST-COST ELECTRIFICATION OPTIONS



B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
LEVEL 1 - DIRECT STAKEHOLDERS IN THE ELECTRIFICATION OF HFs			
Ministry of Public Health (MSanP) **Direction Générale de la Fourniture des Soins (DGES)**	Public sector	Defines norms and standards for the activities and materials used to provide care in public health facilities, from village level to university hospitals.	National CSB/CHRD/CHRR /CHU
MSanP **Directions Régionales de la Santé Publique (DRSP)**	Public sector	Ensures effective implementation of the National Health Policy (NHP) at regional level, especially in line with the Regional Development Plan (RDP). Lobbies at central level to prioritize healthcare facilities in its region.	Regional
Ministry of Energy and Hydrocarbons (MEH) **Energy Emergence Division**	Public sector	Ensures the follow-up and coordination of programmes and projects in the Energy sector, both with TFPs and with other state institutions and departments.	National
MEH **Rural Electrification Development Agency (ADER)**	Public sector-related organization	Supports and monitors the implementation of all MEH projects and programmes in rural areas. Plans, launches, coordinates and monitors all calls for projects (CFP) for the electrification of municipalities and fokontany, based on a multi-sector approach, including the health sector. Ensures that all operators involved in ADER's calls for projects connect HFs to their grid and take HF electricity consumption into account in their business plans.	National / rural areas

B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
LEVEL 1 - DIRECT STAKEHOLDERS IN THE ELECTRIFICATION OF HFs			
Ministry of Public Health (MSanP) **District Management Team (EMAD)**	Public sector	As the cornerstone of the health system, it coordinates and supports basic health centres in the provision of primary health care, as well as district referral hospitals (CHRDs) in the provision of health services (operational level).	District
MSanP **Department of Studies, Planning and Information Systems /DEPSI**	Public sector	i. Draws up and annually updates the health sector sectorization document with the Regional Public Health Departments (DRSP) and the District Public Health Departments (SDSP). ii. Compiles and consolidates work plans for regional health departments, central departments and hospitals (CHRDs/CHRRs/CHUs). iii. Monitors performance and evaluation indicators for Madagascar's public health system. iv. Manages MSanP databases.	National
MSanP **Manaram-penitra hospitals**	Public sector	New hospital infrastructures built since 2009 as part of the Presidential Projects; these health facilities are categorized as large hospitals meeting quality norms and standards both in terms of the care provided and the materials and equipment used.	Regional capital
MSanP **University Hospitals (CHUs)**	Public sector	Generally located in urban areas, university hospitals are third-level referral centres that are expected to treat large numbers of patients. These large hospitals need to have equipment requiring reliable and available energy supplies, such as oxygen generators and concentrators. They are currently connected to the JIRAMA grid and have an unreliable power supply.	Regional capital

B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
LEVEL 1 - DIRECT STAKEHOLDERS IN THE ELECTRIFICATION OF HFs			
Ministry of Public Health (MSanP) **Regional Reference Hospitals (CHRRs)**	Public sector	As second-level referral centres, they provide medical, general surgery, obstetrics, emergency services, as well as specialized medical and surgical care. The CHRRs are located in the regional capitals.	Regional
MSanP **District Reference Hospitals (CHRDs)**	Public sector	Public hospitals with a first level of referral; priority is given to general medicine, general surgery, obstetrics and emergency care. They must subsequently provide comprehensive emergency obstetric and neonatal care called SONUC. This care also includes caesarean sections and blood transfusions.	District
MSanP **Basic Health Centres (CSBs) I and II**	Public sector	These are the health centres closest to the population, providing basic care, regular check-ups for mothers and children (maternity, vaccinations, etc.) and reproductive health.	Municipalities and fokontany
Ministry of Energy and Hydrocarbons (MEH) **Energy Programme Planning and Coordination Unit (MEH/JIRAMA/ADER/ORE)** **Emerging Projects Coordination Unit (UCPE)**	Public sector	Implements the planning and coordination of all energy-related programmes. Working within and with all MEH departments, the ENERGIE Programme Planning and Coordination Unit provides studies, planning, coordination, monitoring and evaluation of ENERGIE Projects/Programmes within the MEH and with other ministerial entities. Coordinates all Energy Sector emergency projects, at MEH level, and acts as a focal point between the Presidency, the Prime Minister's Office and the PTESs with regard to said projects.	National

B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
Ministry of Decentralization and Territorial Planning (MDTP) ***Of which* Local Development Fund (LDF) financed by the World Bank**	Public sector	Allocates subsidies to municipalities for the operation of public facilites, including the operation of CSBs, in particular allowances for dispensing agents and CSB janitors. This grant for the CSBs is to be given to the CSBs through their management committees.	Municipality
Rural communities	Public sector / decentralized local authorities (CDT)	Thanks to the communal electricity tax paid by operators to the municipality, which is earmarked for public lighting, municipalities often call on this fund to pay for electricity for CSBs. In addition, a grant from the MID via the municipality is allocated to the CSBs, but this is intended to pay the allowances of the dispensing agents and CSB janitors.	Rural municipality - CSB1 and 2
JIRAMA	Public sector – state corporation	Thanks to the communal electricity tax paid by operators to the municipality, which is earmarked for public lighting, municipalities often call on this fund to pay for electricity for CSBs. In addition, a grant from the MID via the municipality is allocated to the CSBs, but this is intended to pay the allowances of the dispensing agents and CSB janitors.	National Mainly in urban areas
Ministry of Economy and Finance (MEF) **Budget and Finance Department (DGBF)**	Public sector	Supports the implementation of budget execution for ministries and related government entities, as well as internal and external funding for government programmes and projects. Determines the operating and investment budgets of the Ministry of Public Health and public health facilities.	National
MEF **Customs Department (DGD)**	Public sector	Regulates and proposes texts/laws and customs codes concerning imports, as well as import duties and taxes. Plays a key role in exempting solar equipment from taxes and customs duties.	National

B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
World Bank	TFP	Financing of electrification projects for: 500 CSBs through the LEAD-MEH Project, around 1,000 and more CSBs through the DECIM Project; and the connection of 21 hospital centres to the JIRAMA grid via the LEAD-Jirama Project. Funding for the PRODIGY Digital Governance and Malagasy Identity Management Project, of which the MSanP is one of the beneficiaries for component 2: Acquisition of IT infrastructure/hardware/tablets.	National
European Union (UE)	TFP	Financing of electrification projects for: 500 CSBs through the LEAD-MEH Project, around 1,000 and more CSBs through the DECIM Project; and the connection of 21 hospital centres to the JIRAMA grid via the LEAD-Jirama Project. Funding for the PRODIGY Digital Governance and Malagasy Identity Management Project, of which the MSanP is one of the beneficiaries for component 2: Acquisition of IT infrastructure/hardware/tablets.	National / rural communities
GIZ – PERER Project	TFP	Financing electrification of HFs with solar: 8 CHUs, 6 CHRDs and 4 CSB IIs. Co-financing ADER's calls for projects to electrify rural municipalities.	Provincial - district and communal
UNDP	TFP	Installation of a PV system in the operating theatres of the CHU of Toamasina and 4 PV systems in hospitals: 1 CHU, 2 CHRRs and 1 CHRD in the south of the country. In addition, financing of 6 solar power plants in municipalities in 4 regions of Madagascar via ADER's AP5.	Régional
USAID	TFP	Support for financing private operators in rural electrification, including electrification of healthcare establishments, 35 CSBs in northern Madagascar. Also at the forefront with the Ministry of Health in the supply of medicines and technical equipment.	National

B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
UNICEF	TFP	Technical and financial partner of the Ministry of Health in the supply of medical equipment and the monitoring of child malnutrition.	National
Doctors for Madagascar (DfM)	NGO	Working mainly in southern Madagascar, DfM, in collaboration with private electricity operator ANKA Madagascar, plans to electrify 50 CSBs in the south. DfM also supports hospitals and health centres by building and renovating essential facilities to keep them in good condition. Also provides medical equipment and training in maintenance and upkeep.	In southern Madagascar
WeLight **ANKA Madagascar** **AUTARSYS** **HERI** **NANOE** **HIER**	Private Sector	Private operators working in rural electrification using renewable energy technologies, mainly PV - some offer mini hydro. Some carry out specific projects targeting the electrification of CSBs for TFPs/NGOs.	Rural communities

B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
LEVEL 2 - INDIRECT STAKEHOLDERS IN THE ELECTRIFICATION OF HFs			
Ministry of Energy and Hydrocarbons (MEH) **ORE/ARELEC** **Office de Régulation de l'électricité**	Public sector-related organization	Ensures compliance with legal frameworks in the energy sector, monitors all legal aspects such as concession contracts, energy purchase contracts including business plans of private operators in rural electrification projects, including tariff validation.	National
Ministry of Digital Development, Digital Transformation, Posts and Telecommunications (MNDPT)	Public sector	Through the digitization projects of all ministries and state agencies, as well as the DECIM project, the MNDPT must ensure that energy is available to beneficiary entities.	National
Ministry of Commerce **Bureau des Normes de Madagascar (BNM)**	Public sector-related organization	In charge of the national strategy for standardization and quality assurance of goods and services supplied by companies and operators in Madagascar, including electrification materials and equipment.	National
National Statistics Institute (INSTAT)	Public sector	Produces the nation's official statistics, and elaborates official basic data for socio-economic analyses, human development indices and social profiles. Conducts field surveys on Malagasy household living standards, demographics, and other basic data including electrification access rates and HF locations.	National

B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
French Development Agency (AFD)	TFP	Support for the financing of ADER's Call for Projects for solar mini-grids in six regions of Madagascar.	Rural communities
UNIDO	TFP	Support for the financing of mini-hydro rural electrification projects in 2 regions of Madagascar.	Municipalities
WHO	TFP	As a major player in the health sector, working on disease control projects and also on the construction and rehabilitation of health infrastructures in Madagascar, WHO, through its WASH (Water, Sanitation, Hygiene and Health) programme, is working on energy in health facilities. In collaboration with the Ministry of the Environment, WHO is supporting the inventory of GHGs in the country's health system, and hopes to have results by the end of the year.	National
UNOPS	TFP	Established in Madagascar in 2022, UNOPS works in public procurement and infrastructure. It does not have the same model as other agencies: no centralized funding from NYC (core funding) by member countries. On the other hand, it does a lot of purchasing of solar panels / solar kits and could therefore take on the supply of solar panels for private operators, ministry projects (e.g. MEH for LEAD/DECIM) or PTFs.	
UNFPA	TFP	Works to improve reproductive health in Madagascar in order to reduce maternal and infant deaths, combat gender-based violence and prevent sexual exploitation and abuse.	National
Gavi, the Vaccine Alliance	TFP	Supports and contributes to the achievement of the national immunization objectives of the MSanP.	National

B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
JICA	TFP	Supports the Ministry of Health's policy of sustainable improvement in the quality of healthcare and healthcare services, through the ongoing optimization of the framework and working conditions of healthcare staff.	National
Médecins du Monde	NGO	HI has been present in Madagascar for over 30 years, facilitating access to healthcare for people with disabilities, contributing to the emergency humanitarian response and, in particular, providing assistance to vulnerable people affected by the COVID-19 pandemic.	National
Humanité & Inclusion (HI)	NGO	HI has been present in Madagascar for over 30 years, facilitating access to healthcare for people with disabilities, contributing to the emergency humanitarian response and, in particular, providing assistance to vulnerable people affected by the COVID-19 pandemic.	National
Doctors without Borders (MSF)	NGO	Provides medical assistance to vulnerable populations, particularly in southern Madagascar. Deploys material and sanitary aid to improve the living conditions of people affected by natural disasters, mainly in Grand Sud and Mananjary after the 2 cyclones.	Southern Madagascar
CARE	NGO	CARE has been present in Madagascar for over 25 years, working on projects in a wide range of fields, including health. It is also a major player in responding to the emergencies that regularly affect the country (drought, cyclones, etc.).	National
Marie Stopes International (MSI)	NGO	Present in Madagascar since 1992, MSI works with the government to provide care for reproductive health and communicable diseases in Madagascar's 23 regions.	National
Catholic Relief Services (CRS)	NGO	Works with MSanP to set up mobile clinics to extend access to vaccinations and healthcare.	National

B. Stakeholder mapping

1 2 3 4 5 6 7 8 9 10

STAKEHOLDER	SECTOR / ORGANIZATION	ROLE IN THE HEALTH-ENERGY NEXUS	INTERVENTION LEVEL
Seed Madagascar	NGO	Integrates diverse programmes in community health, rural livelihoods, educational infrastructure and conservation to support long-term sustainable change. A six-month solar pilot project in 2 villages has been set up to electrify 2 school buildings and teachers' lodgings, with the aim of improving access to clean, affordable energy for pupils' households in the two rural communities.	South-east regions
FONDEM	NGO	A manager of EU and AFD funds, it works to develop income-generating activities using electricity for economic development.	National
GRET	NGO	Development and financing of rural electrification projects using renewable energies, particularly in the communes of Bealalana, Sahasinaka, Sahatona and Tolongoina through EU funding.	National
TANY MEVA	NGO	Elaboration and search for financing of rural electrification projects using renewable energies (mini-hydro and mini-grids) in the communes of Ambaravaranala, Amboasary Nord, Andriantsemboka, Andriantsiazo, Andina and Kianjandrakefina.	National
Organisation Sanitaire Tananarivienne Inter-Entreprises (OSTIE) **Service Médical Inter-Entreprises**	Private Sector	A health organization present in Madagascar since 1955, it has over 160,000 members, with 9 health centres in Tana and more than 56 branches. A pilot project to electrify a centre with solar panels is underway, with a budget of USD 20,000 from the organization's own financing.	Antananarivo
AFRICA GREENTEC **Economic Operator in renewable energy (RE)**	Private Sector	Economic operator working in rural electrification using RE technologies – PV.	Rural communities

C. Intervention mapping

1 2 3 4

PROGRAMME/ PROJECT	BRIEF DESCRIPTION	FINANCING SOURCES	STATUS	AMOUNT/ BUDGET	TYPES OF TECHNOLOGY	ZONES & TYPES OF HF CONCERNED	BUSINESS MODELS
LEVEL 1 - DIRECT STAKEHOLDERS IN THE ELECTRIFICATION OF HFs							
Least-Cost Electricity Access Development Project LEAD	*LEAD-MEH* Project to develop access to low-cost electricity Electrification of 500 CSBs in Madagascar.	World Bank	47 electrified CSBs (completed) 453 procurement underway	USD 15M	PV	CSB1 and CSB2 in Madagascar's 23 regions	Capex: Malagasy State Loan WB Opex: Local authorities' funds
	LEAD - JIRAMA Electrification of 500 CSBs in Madagascar.	World Bank	Procurement in progress	USD 2M	JIRAMA grids (On-grid)	Regions : Alaotra (1), Amoron'i Mania (2), Analamanga (1), Androy (1), Anosy (1), AtsimoAndrefana (1), AtsimoAtsinanana (3), Diana (3), Haute Matsiatra (2), Ihorombe (1), Sava (1), Sofia (2)	Capex: Borrowing Malagasy State BM Opex: Hospitals' own funds and state budget via MSanP
Digital Connectivity and Energy for Inclusion Project in Madagascar (DECIM)	The aim of the project is to expand access to renewable energy and digital services in Madagascar. Electrification of CSBs **not electrified** by the LEAD project (around 1,000 CSBs).	World Bank	Project Coordination Unit: Implementation from 2024	USD 60M for CSBs and schools	PV	Rural communities	Capex: Borrowing Malagasy State BM Opex: Decentralized local authorities' own funds

C. Intervention mapping

1 2 3 4

PROGRAMME/ PROJECT	BRIEF DESCRIPTION	FINANCING SOURCES	STATUS	AMOUNT/ BUDGET	TYPES OF TECHNOLOGY	ZONES & TYPES OF HF CONCERNED	BUSINESS MODELS
LEVEL 1 - DIRECT STAKEHOLDERS IN THE ELECTRIFICATION OF HFs							
Promotion de l'Electrification Rurale par les Energies Renouvelables (PERER) (Promotion of Rural Electrification through Renewable Energies)	Electrification with solar panels of 18 health establishments, including 8 CHUs, 4 CSB IIs, and 6 CHRDs.	World Bank GIZ German Cooperation	Project completed in 2023	USD 1.5M	PV	CHUs: urban areas CHRs: rural areas CSBIIs: Tana	Capex: GIZ grants Opex: HF equity
Africa Minigrids Program (AMP)	Supply, installation and commissioning of 2 solar photovoltaic generation plants for the autonomous electrification of emergency surgery and emergency maternity operating theatres; the blood transfusion centre of the Toamasina hospital centres and 4 CHRRss and CHRD in the Atsimo Andrefana region. Construction of 6 solar power plants in the Anosy and Atsimo-Andrefana regions, with connection of public health centres.	World Bank UNDP	Project completed this year 2023 Technical acceptance: 2022-2023		PV	CHU Toamasina, CHU Toliara, CHRR Taolagnaro, CHRR Ambovombe, CHRD Befotaka	Capex: Subsidies Opex: Hospitals' own funds

C. Intervention mapping

1 2 3 4

PROGRAMME/ PROJECT	BRIEF DESCRIPTION	FINANCING SOURCES	STATUS	AMOUNT/ BUDGET	TYPES OF TECHNOLOGY	ZONES & TYPES OF HF CONCERNED	BUSINESS MODELS
Private sector - B2B **Rural electrification programme**	Project to electrify 120 rural villages not connected to the grid by a private operator, WELIGHT, to provide access to clean, affordable energy. In addition to households and businesses, the project will also benefit schools, health centres* and public spaces. **1 to 2 health centres per village are planned*	European Investment Bank (EIB), Triodos Investment Management and EDFI ElectriFI	In progress (project launch and first dis-bursement 1st half of 2023)	EUR 19M including EUR10M from the EIB	Solar mini-grids	Rural areas CSB	Capex: Bank loans Opex: Electricity sales
Electrification of health centres	Collaborative project between Doctors for Madagascar (DfM) and the private operator ANKA Madagascar for the electrification of 50 CSBs in the South.	Financial partners DfM	In progress		PV	Rural areas 50 CSB	Capex: DfM grant Opex: DfM subsidy
Power Africa-Southern African Energy Program **(SAEP)**	Electrification of rural communities, including health establishments.	USAID and private operators	Closed in 2023		PV	Rural areas 35 CSB	Capex: Subvention et Fonds Op Privés Opex: Electricity sales

C. Intervention mapping

1 2 3 4

PROGRAMME/ PROJECT	BRIEF DESCRIPTION	FINANCING SOURCES	STATUS	AMOUNT/ BUDGET	TYPES OF TECHNOLOGY	ZONES & TYPES OF HF CONCERNED	BUSINESS MODELS
Universal Energy Fund (UEF) /SEforALL Financial facility to promote universal access to energy	Results-based financial support to promote access to sustainable energy. UEF provides performance-based CAPEX investment grants to companies deploying decentralized renewable energy projects such as mini-grids.	SEforALL	In progress 30 grant agreements signed since 2020	USD 665,000	Solar mini-grids	Rural areas	Capex: UEF + private operators' own funds Opex: Electricity sales
AADER calls for projects **AP0 (2015) to AP9**	Electrification of rural villages and communes with connection of CSBs through calls for projects.	STATE (MEH/ADER) PTS: EU, GIZ, UNDP, AFD, PIC, UE, USAID	AP6 to AP9 in progress		Solar mini-grids Mini-hydro	Rural communities CSBs/CHRDs	Capex: PTES subsidies + private operators' own funds Opex: Electricity sales
MEH/JIRAMA	Hybridization of 36 isolated JIRAMA thermal plants using solar systems.	STATUS	Under tender	**USD 25M**	Hybrid (generator/solar)	Districts CHRDs and CSBs	Capex: Budget ÉTAT: Opex: Electricity sales

D. Policy and regulatory framework

NATIONAL HEALTH POLICY (NHP) (2020 - 2024) The NHP provides a general strategic framework to guide the country's response to public health issues. It represents **a benchmark to which all players are obliged to conform for any health or health-related initiative.** Under the leadership of the Ministry of Public Health, it is periodically updated in line with the Sustainable Development Goals (SDGs), the General State Policy (GSP) and the National Development Plan (NDP).	**LAW N°2017-020 OF 18 APRIL, 2018 ON THE ELECTRICITY CODE OF MADAGASCAR (CODELEC)** Reforms to liberalize the energy sector and strengthen the roles of key players in the sector, notably the Rural Electrification Agency and the Electricity Regulation Authority. It also promotes better development of rural electrification in Madagascar through rural electrification and mini-grids.
HEALTH SECTOR DEVELOPMENT PLAN (PDSS) 2020-2024 The PDSS represents the national reference for all health programme planning, resource mobilization & allocation, advocacy, and monitoring & evaluation of interventions in the health sector. Eight strategic axes are defined to improve access to healthcare for the population.	**DECREE N°2002-1550 OF 3 DECEMBER, 2002, CREATING THE RURAL ELECTRIFICATION DEVELOPMENT AGENCY (ADER)** To implement rural electrification projects based on regional master plans, prioritizing locally available renewable energy resources.
MANUAL OF STANDARDS AND PROCEDURES FOR THE NATIONAL HEALTH INFORMATION SYSTEM IN MADAGASCAR The aim is to provide all levels of the healthcare system with complete, reliable and usable data and information, in real time, to enable appropriate decision-making.	**LAW N°2017-021 REFORMING THE NATIONAL ELECTRICITY FUND (FNE)** Funds to finance rural electrification programmes. This fund should offer financial tools to actively contribute to the promotion of renewable energies and energy efficiency in rural areas.
NORMS AND STANDARDS FOR CHRDs IN MADAGASCAR A framework of reference to which all players in the public health sector are obliged to conform for all hospital development initiatives. It groups together all the standards in terms of a CHRD's spatial and environmental organization, infrastructure, materials and equipment, human resources and activities.	**ORDER NO. 9438/2018 ON THE HARMONIZATION OF TRANSFER OF SUBSIDIES RELATED TO THE OPERATION ALLOCATED BY THE STATE FOR THE BENEFIT OF DECENTRALIZED TERRITORIAL COMMUNITIES (CTD)** Allocation of operating subsidies to municipalities and subsidies for CSBs via the commune for payment of allowances to CSB dispensers and janitors.
NORMS AND STANDARDS FOR CSBs IN MADAGASCAR Standards document designed by the MSanP to serve as a reference guide for improving the quality of services offered. The document highlights standards for the structuring of health centres: categorization and minimum package of activities; infrastructure, equipment and resources; as well as procedures for setting up CSBs.	**Tax benefits: Exemption from import and customs duties** The following are eligible for these exemptions: **donations of materials and equipment intended for decentralized local authorities; and equipment for the supply of renewable energies** as part of *rural* electrification *(Government advisory note n°040/2022-PM/SGG/SC)*.

E. Energy needs assessment for CSBs

CAPEX evaluation for CSB

ARTICLE	VALUE	UNIT	COMMENT
PV + controller	800	$/kWc	Reinforced, roof-mounted installation.
Inverter	800	$/kW	
Batteries	250	$/kWh	kWh nominal for lead-acid battery
Indoor wiring	1,000-1,200	$	Wiring for a 5-room or 7-room (average) CSB, including protections
Fixed - technical building	2,000	$	
Variable - technical building	40	$/kWh	
Lighting + tablet	150-360	$	Depends on plant size
Sterilizer	1,200	$	
Development	20%		Of equipment costs
Transport and installation	25%		Equipment without sterilizer Depending on access ibility, average value

COMMENTS :

- Prices and development costs will vary according to project/intervention size/scale. The costs shown here are for an estimated batch of 50 power plants.
- Costs can vary around +20%.

Basic needs CSB1

Total Demande & Résumé

Heure			1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr	13 hr	14 hr	15 hr	16 hr	17 hr	18 hr	19 hr	20 hr	21 hr	22 hr	23 hr	24 hr
Energie	(Wh/hr, W)		161	161	161	161	161	161	433	443	181	171	181	171	171	171	181	171	171	443	518	236	236	236	236	236

Nombre de logement	1
Energie journalière moy (Wh)	1 837
Energie de nuit moy (Wh)	3 704
Total Energie moy par jour (Wh)	5 540
Puissance max (W)	518

Input
Référence directe
Calcul
En dur
Pas utilisé

Notes

* CSB1 selon les normes du ministères de la santé (MsanP), incluant un kit de stérilisation

Equipements électriques

	Puissance nom. (W)	Qté	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr	13 hr	14 hr	15 hr	16 hr	17 hr	18 hr	19 hr	20 hr	21 hr	22 hr	23 hr	24 hr	Usage (hrs)	Wh /jour
Éclairage intérieur	10	25	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.50	0.50	0.50	0.50	0.50	0.50	6.6	1650
Éclairage extérieur	15	4	0.80	0.80	0.80	0.80	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.80	0.80	0.80	8.8	528
Radio	10	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3	30
Charge de téléphone	5	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.00	0.00	0.00	0.00	2.4	120
Ventilateur	80	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.4	432
Imprimante	100		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	0
Ordinateur / tablette	60		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.5	0
Microscope	70		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3	0
Poupinel 20L	400	1	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	3.2	1280
Energie par heure (Wh/hr, W)			98	98	98	98	98	98	370	380	118	108	118	108	108	108	118	108	108	380	455	173	173	173	173	173		
Cons. Journalière (Wh)	4 040																											

Réfrigération

	Puissance nom. (W)	Qté	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr	13 hr	14 hr	15 hr	16 hr	17 hr	18 hr	19 hr	20 hr	21 hr	22 hr	23 hr	24 hr	Usage (hrs)	Wh /jour
Réfrigérateur à vaccin	250	1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	6	1500
Energie par heure (Wh/hr, W)			63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63		

SOURCES :

- Data collected through interviews and observations during field visits (TTA-AIDES, 2023).
- Modern energy services for healthcare facilities in resource-constrained environments (WHO + World Bank, 2015).
- Guidelines for healthcare facility categories (USAID, 2009)
- Cold chain technology guide (GAVI, 2023)

Basic needs CSB2

Total Demande & Résumé

		1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr	13 hr	14 hr	15 hr	16 hr	17 hr	18 hr	19 hr	20 hr	21 hr	22 hr	23 hr	24 hr
Heure		1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr	13 hr	14 hr	15 hr	16 hr	17 hr	18 hr	19 hr	20 hr	21 hr	22 hr	23 hr	24 hr
Energie	(Wh / hr, or W)	218	218	218	218	218	218	463	483	231	241	261	241	271	271	341	256	206	478	669	417	409	401	401	325

Nombre de logement	1
Energie journalière moy (Wh)	2 596
Energie de nuit moy (Wh)	5 077
Total Energie moy par jour (Wh)	7 673
Puissance max (W)	669

Input
Référence directe
Calcul
En dur
Pas utilisé

Notes

* CSB2 selon les normes du ministères de la santé (MsanP), incluant un kit de stérilisation

Logement du personnel

	Puissance nom. (W)	Qté	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr	13 hr	14 hr	15 hr	16 hr	17 hr	18 hr	19 hr	20 hr	21 hr	22 hr	23 hr	24 hr	Usage (hrs)	Wh /jour
Lumière - intérieur - LP	10	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	6	120
Lumière - extérieur - LP	20	1	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	12	240
Radio - LP	10	1		0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	3.1	31
TV - LP	35	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.80	0.80	0.00	3.2	112
Chargeur téléphone - LP	5	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.80	0.00	0.00	0.00	2.4	24
Ventilateur - LP	80	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.60	0.60	0.60	0.60	0.00	3	240
Réfrigérateur - LP	70	1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	6	420
Energie par heure (Wh/hr, W)			38	38	38	38	38	38	23	23	23	18	18	18	18	18	18	18	18	18	122	150	142	134	134	58		
Cons. Journalière (Wh)	1 187																											

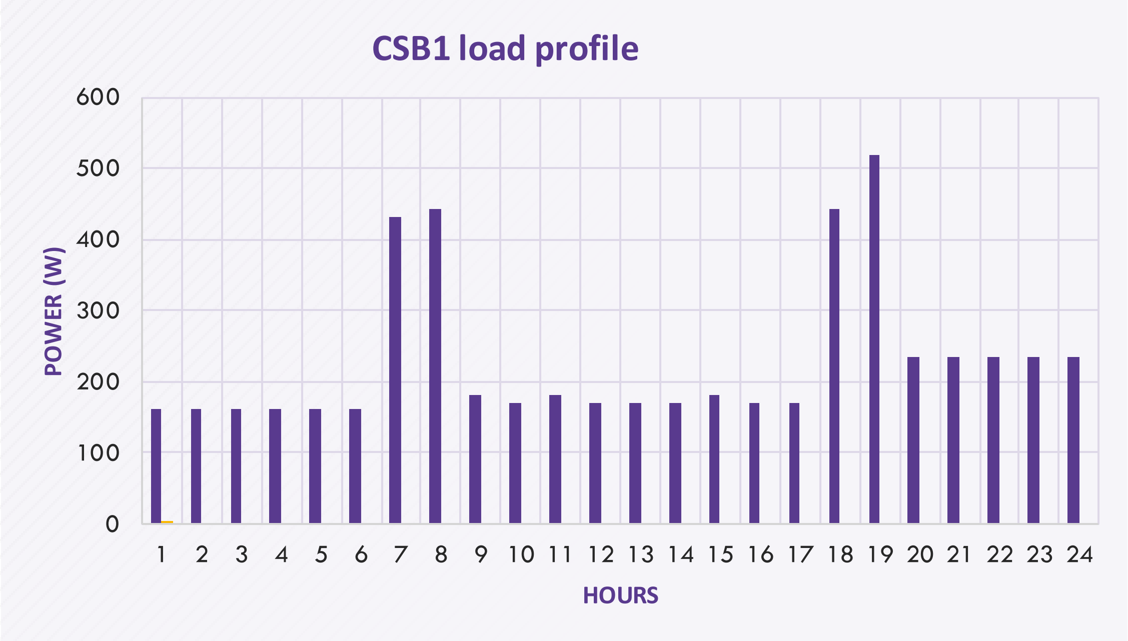
Equipements électriques

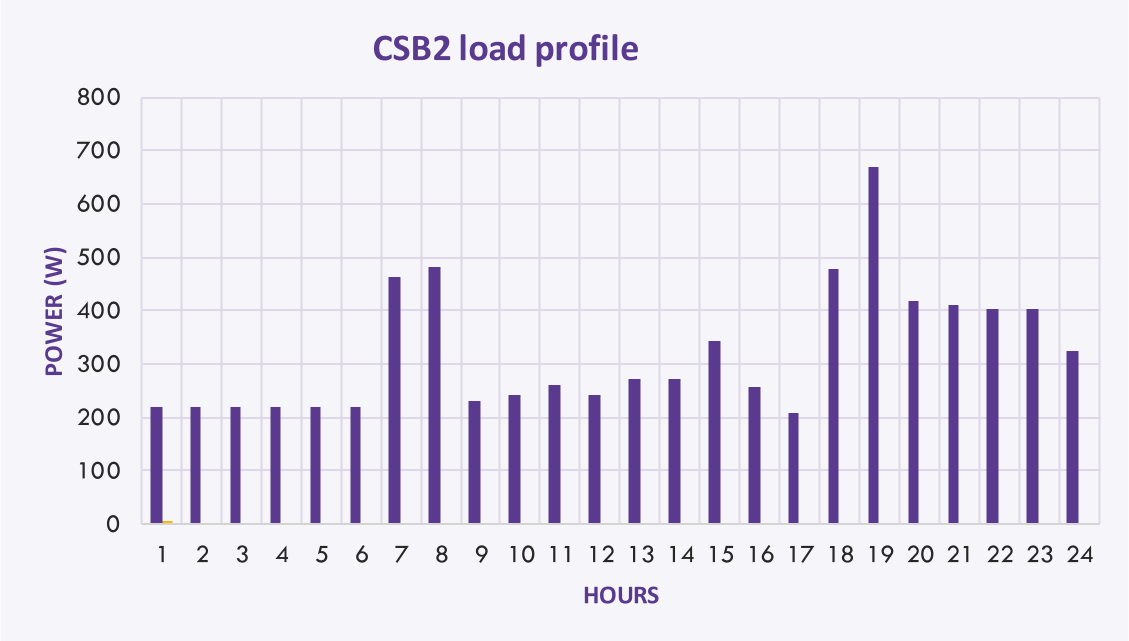
	Puissance nom. (W)	Qté	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr	13 hr	14 hr	15 hr	16 hr	17 hr	18 hr	19 hr	20 hr	21 hr	22 hr	23 hr	24 hr	Usage (hrs)	Wh /jour
Éclairage intérieur	10	29	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.50	0.50	0.50	0.50	0.50	0.50	6.6	1914
Éclairage extérieur	15	5	0.80	0.80	0.80	0.80	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.80	0.80	0.80	8.8	660
Radio	10	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3	60
Charge de téléphone	5	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.00	0.00	0.00	0.00	2.4	240
Ventilateur	80	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.4	432
Imprimante	100	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1	100
Ordinateur / tablette	60	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.5	90
Microscope	70	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3	210
Poupinel 20L	400	1	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.80	0.00	0.00	0.00	0.00	0.00	3.2	1280
Energie par heure (Wh/hr, W)			118	118	118	118	118	118	378	398	146	161	181	161	191	191	261	176	126	398	485	205	205	205	205	205		
Cons. Journalière (Wh)	4 986																											

Réfrigération

	Puissance nom. (W)	Qté	1 hr	2 hr	3 hr	4 hr	5 hr	6 hr	7 hr	8 hr	9 hr	10 hr	11 hr	12 hr	13 hr	14 hr	15 hr	16 hr	17 hr	18 hr	19 hr	20 hr	21 hr	22 hr	23 hr	24 hr	Usage (hrs)	Wh /jour
Réfrigérateur à vaccin	250	1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	6	1500
Energie par heure (Wh/hr, W)			63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63		
Cons. Journalière (Wh)	1 500																											

Needs assessment - Load profiles





F. Technical specifications

PV structure

FEATURES	SPECIFICATION
Orientation	North or East/West (subject to availability)
Angle	5 - 25 degrees
Foundation type	Reinforced concrete or ground screws (if applicable) In high-wind areas, consider ground installation if the roof is not strong enough.
Height from ground level to lowest point of PV modules	Ground-mounted: ≥ 1 m Solar pergola: ≥ 3 m
Product warranty	≥ 10 years
Bolts and mounting hardware	SS316 stainless steel.
Materials used	Anodized aluminum with a minimum coating thickness of 20µm (AA20)

Charge controllers

FEATURES	SPECIFICATION
Number of panels per MPPT	≤ 3
Waterproofing	≥ IP20, indoor installation
Product standards	IEC 62109-1 and/or UL 1741
Maximum efficiency	>97%
Technology	MPPT
PV string voltage	<250Vdc
Product warranty	≥ 5 years

Lead-acid batteries

FEATURES	SPECIFICATION
Nominal battery voltage	≤ 60 V (DC)
Battery type	Lead Acid
Number of cycles	≥ 2000
Self-discharge rate	<3% / month @ T=20°C
Depth of discharge	≤ 70%
Product warranty	≥ 3 years
Service life for selected design	≥ 5 years @ 50% DoD
Product standard.	IEC 61427-2005 and IEC-60896-21

PV modules

FEATURES	SPECIFICATION
PV cell technology	Polycrystalline or monocrystalline silicon
Power tolerance	> 0 %
Yield under STC conditions	≥ 19 %
System voltage	≥ 1000 V (DC)
Performance guarantee	Maximum power degradation under STC of 10% for the first 10 years and 20% over a 25-year period
Product warranty	≥ 10 years
Product standard	IEC-61215, IEC 61730-1, IEC 61730-2, IEC 61701, IEC TS 62804

Battery inverter

FEATURES	SPECIFICATION
Nominal battery voltage	< 60 V (DC)
Type of output of all battery inverters.	Single-phase, bidirectional if back-up, 220V, 50Hz nominal
Maximum yield	≥ 95%
Harmonic distortion	≤ 4%
Protection	Minimum depth of discharge, overload and overcurrent
Ambient temperature range for correct operation	15°C - 45°C
Product warranty	≥ 5 years
Product standard	IEC 62109 o UL 1741, IEEE 1547

Li-Ion batteries

FEATURES	SPECIFICATION
Nominal battery voltage.	≤ 60 V (DC)
Battery type	Li-ion
Number of cycles	≥ 5000 cycles @DoD=80% @0.25C @T=20°C
Self-discharge rate.	≤ 4%/month @T=20°C
Ambient temperature range for correct operation	15°C - 45°C
Capacity guarantee (in years)	60% usable energy guarantee for 10 years (or equivalent)
Product warranty	≥ 3 years
Product standard.	IEC 62619 and UN38.3 or equivalent.

G. Questionnaire for field visits

1 2

Global Energy Alliance for People and Planet

I. Identité administrative :

Région :	District :	Commune :
Fokontany :		
Coordonnées GPS de la structure :		
Nom de l'enquêteur :		
Nom de la personne interviewée :	Poste occupé : Fonction :	
Nom de l'infrastructure de santé :	Catégorie : ☐ CSB 1 ☐ CSB 2 ☐ CHRD	
Nom du responsable :	Téléphone : E-mail :	Fonction : Statut :

II. Information sur la localité :

Nombre de population de la localité :

Accessibilité : ☐ Routes asphaltées pour voiture ☐ Route secondaire ☐ Route pour moto ☐ Pas de route disponible ☐ Autres : ______

Opérateur téléphonique : (entourez le type de couverture) ☐ Telma (2G/3G/4G/5G) ☐ Orange (2G/3G/4G/5G) ☐ Airtel (2G/3G/4G/5G)

Activité économique pondérant de la localité :

Contrainte économique de la localité (marché, route, insécurité, etc.):

Maladies courantes de la localité :

Catégories de personnes desservies (Aisé, moyen, vulnérable, etc.) :

III. Généralités sur la structure sanitaire

Services	Nb personnels affectés	Nb Bâtiments	Nb salle	Nb lits	Occupation moyenne mensuelle de lits (%)	Frais de service par personne	Fréquentation journalière

Existence de plan : ☐ Oui [1] ☐ Non

Existe-t-il des bâtiments construits récemment ? si oui, combien ? Nombre de salle ?

[1] Si Oui, le prendre en Photo

AIDES tta

Page 1 sur 5

Est-ce que vous prévoyez des extensions dans l'avenir (2 – 3 ans) ?

Construction : Date de construction : ______
- Etat de l'infrastructure : ☐ En bon état ☐ Mauvaise état
- Matériaux de construction : ☐ Parpaing ☐ Brique ☐ Autres ______
- Matériel de toiture : ☐ Tôle ☐ Tuile ☐ Autres ______
- Impact des conditions climatiques
- Clôture ☐ Oui ☐ Non
- Espace pour construction d'un système solaire PV dans la parcelle ☐ Terrain ☐ Toiture ☐ Aucun
  Mesure approximative : ______
- Salle d'attente ☐ Oui ☐ Non Si non, en a-t-on besoin ? ☐ Oui ☐ Non

Ressources Humaines (organisation interne / qui fait quoi ? / staff d'appui qui n'est pas médical ?) /quelqu'un du village donne l'appui ? / Structure administrative ? (PRECODESA, COGES, ministère de la Santé) :

Equipe de gestion :
- Durée moyenne d'affectation des personnels (Est-ce qu'il y a une grande rotation pendant l'année ou pendant 5 ans ? ou un temps pendant lequel l'équipe n'est pas présente à la structure ?) ______
- Généralement, en quelle période il y a affectation des personnels (e.g. au début de l'année, pendant les élections politiques, etc.)
- Qui prend les décisions sur la formation sanitaire ?
  ☐ Le personnel local ☐ Le personnel régional ☐ Autres ______

Qui gère la structure ? ☐ Privé ☐ Public ☐ Mixte

Quel est le modèle de viabilité financière de la structure (frais des services et comment on gère cet argent) ? (Fonctionnement, investissement, etc.)

Quelles sont les sources de financement ?

Est-ce que la structure reçoit une ou des aides financières pour assurer son fonctionnement ?

Type de contribution pour le financement	Source financière	Montant
Salaire		
Intrants (médicaments, outils, matériels, etc.)		
Autres :		

Y a-t-il des retards sur le salaire des personnels ? ☐ Oui ☐ Non

Couverture géographique : Nombre de village (fkt) : Population desservie : ______

Disponibilité des médicaments :

D'où viennent-ils ? ______ A quelle Fréquence ? ______

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Est-ce que le staff dort sur place ? ☐ Oui ☐ Non

La structure de santé bénéficie-t-elle de soutien de la part d'ONGs / Autres bailleurs de fonds ☐ Oui ☐ Non

Bailleurs	Type de aide	Montant

IV. Système électrique

Centre électrifiée ☐ Oui ☐ Non

Type : ☐ Réseau JIRAMA ☐ Autre fournisseur ☐ PV indépendant ☐ GE ☐ Autres

Qui l'a installé ? ______

Quand ? ______

Puissance si PV ou GE (kW, KVA) : ______

Electricité assuré :
- Nombre d'heures par jour : ______ Nombre de jours par semaine : ______
- Plage horaire de fonctionnement pendant la journée : ______

Câblage et prise :
☐ Suivent les normes ☐ Ne suivent pas les normes ☐ Fonctionnel ☐ Non fonctionnel
☐ De bonnes qualités ☐ De mauvaises qualités

Système de protection disponible ☐ Oui ☐ Non

Type : Mise à la terre : ☐ Oui ☐ Non

Age de l'installation électrique : ______

Qui détermine la capacité des disjoncteurs (breakers) : ☐ Le constructeur du bâtiment ☐ Un projet spécifique électrique ☐ Autres ______

Circuits autonomes :

Existence de batterie : ☐ Oui ☐ Non Nombre : Caractéristiques [2] :

Qui paie l'électricité ? Combien mensuellement (Ar)?

Est-ce que l'électricité fournie est suffisante par rapport aux besoins ? ☐ Oui ☐ Non Pourquoi ?

Si la source est un générateur
☐ Diesel ☐ Essence ☐ Autres ______
Dépenses mensuelles en carburant : ______
Prix du litre de carburant : ______
Qui paie ?
Heures de fonctionnement par jour : ______
Jour de fonctionnement par semaine : ______
Nombre de semaine par mois : ______

Qui assure l'entretien et la maintenance du système électrique ?

[2] Tension et capacité

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G. Questionnaire for field visits

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V. Système chauffage

Besoin de source chauffage ? ☐ Oui ☐ Non — *Si oui,* ☐ Chauffer de l'eau ☐ Intrants médicaux ☐ Chauffage pour patient ou équipe

Est-ce qu'on cuisine dans la structure sanitaire ? ☐ Oui ☐ Non — ☐ Pour les patients ☐ Pour le personnel

VI. Système d'illumination/Eclairage

Nombre de lampes :
Type : ☐ LED ☐ Lampe à Incandescence ☐ Lampe fluocompacte ☐ Autres

Energétiquement efficaces : ☐ Oui ☐ Non
Marque :
Disponibles dans le marché local : ☐ Oui ☐ Non

Eclairages extérieurs : ☐ Oui ☐ Non

Éclairage intérieur dans tous les services : ☐ Oui ☐ Non

A-t-on remplacé l'éclairage à cause de pannes, par le même type d'éclairage : ☐ Oui ☐ Non

Qui paie les ampoules ? — *Qui fait le remplacement ?*

VII. Equipements

Equipements disponibles	F/NF	Nombre	Tension (V)	Puissance (W)	Volume (litre)	Qui a octroyé/acheté le matériel	Suivant les normes du MinSaP (Oui/Non)
Concentrateur							
Stérilisateur							
Bistouri							
Pousse seringue							
Couveuse							
Lampe à fente							
Frigo							
Fer à repasser							
Lampe							
ECG							
Chauffe-eau							
Bouilloire							

Equipements administratifs (3) *:*

Chaine de froid :
Nombre de Frigo : Type (source) : Caractéristique (4) :
Etat : ☐ Fonctionnel ☐ Non Fonctionnel

A quoi sert ces frigos ? ☐ Conservation des vaccins, ☐ Conservation des médicaments, ☐ Stérilisateur ☐ Conservation des nourritures, ☐ Autres

Est-ce qu'il a des homologations internationales (comme ONU, OMS, ECE, etc.) ?

Est-ce qu'il y a d'autres équipements qu'on planifie d'ajouter dans les 2 -3 ans à venir ?

Qui assure la maintenance de ces matériels ?

(3) Chargeurs de téléphones, ordinateurs, imprimantes, etc.
(4) Tension, Puissance, Volume

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A quelle fréquence dans une années ?

Autres équipements utilisés par les personnels habitants dans le bâtiment	Nombre	Tension	Puissance	Volume
Lampe				
Ventilateur				
Radio				
TV				
Frigo				

VIII. Eau, Hygiène, Assainissement

Source d'eau :

Comment l'eau arrive dans la structure ? — *Disponibilité par jour (heures/jour) :* *Disponibilité par semaine (jours/semaine) :*

Existence de traitement/Purification de l'eau : ☐ Oui ☐ Non — *Type de traitement :* ☐ Chlore ☐ Filtre ☐ Autres

Utilisation de l'eau : ☐ Boire ☐ Nettoyer/Lavage ☐ Autres — *Quantité d'eau potable nécessaire par jour (litre) :* *Quantité d'eau non potable nécessaire par jour (litre) :*

Nombre de bornes fontaine dans la structure : — *Nombre de points de laves-mains :*

Stockage d'eau : ☐ Oui ☐ Non — *Capacité (litre) :* — *Type* (5) *:*

Nombre de toilette pour homme : *Type :*

Nombre de toilette pour femme : *Type :*

Existence de zone de lavage de linge ☐ Oui ☐ Non — *Type :* ☐ Machine à laver ☐ Bassin

Utilisation de : ☐ Chlore ☐ Savon — *Existence de zone pour le séchage :* ☐ Oui ☐ Non

Gestion de déchet :
- *Ségrégation de déchets avec des bacs/fosses séparées* ☐ Oui ☐ Non
- *Comment les déchets sont séparés ?*
- *Zone de déchets délimités avec accès restreint* ☐ Oui ☐ Non

IX. Mot de la fin

Quels sont les plus grands défis selon vous de la structure de Santé liés à l'électricité ?

Commentaires de l'enquêteur ?

(5) Plastique, en dur, autres

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SUSTAINABLE ENERGY FOR ALL

Global Energy Alliance for People and Planet
GEAPP

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